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December, 1934 Number 12

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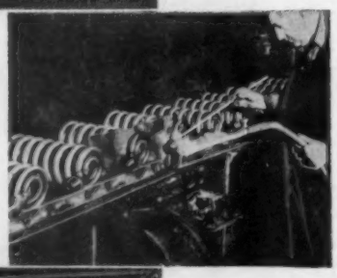

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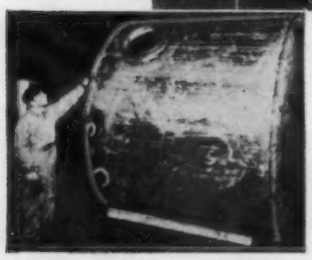

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THE WELDING ENGINEER

LEADING ARTICLES IN THIS ISSUE

DECEMBER, 1934

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The Welding Engineer

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A. C. vs. D. C. Welding . . .

■ By R. K. HOPKINS
Director of Metallurgical Research
The M. W. Kellogg Company

A large tonnage of pressure vessels has been welded with the a.c. process in the Kellogg plant. The author reveals why a.c. welding was adopted for certain types of work, and compares results with those obtained with d.c. welding.

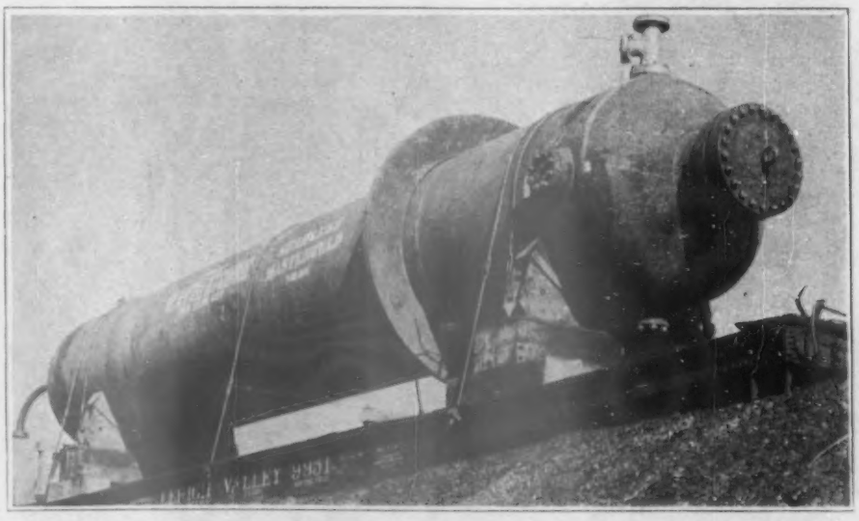
DURING the past few years, welding engineers have engaged in a great deal of controversy on the pros and cons of alternating and direct current for use in welding. Both of these types of welding have been known for a great many years, but d.c. has been used more extensively in the United States than a.c.

In the past 4 or 5 years, a.c. welding has commanded more and more attention in this country, and in the past two years has been, at least partially, adopted by several of the leading fabricators. The experience of The M. W. Kellogg Company had been entirely with d.c. welding, except for a few unimportant experiments run on small portable a.c. welding transformers, until, in 1932, it was decided to make a thorough investigation of the two types of welding, with the idea of adopting the better of the two, if one should show superiority over the other. It was felt that after such an investigation, regardless of its outcome, at least the members of the Kellogg company would know the relative merits of the two processes.

Previous Experience With Single-Operator D.C. Units

The d.c. equipment used by this company was the single-operator type generator, with either built-in or external reactance. In many instances two generators are driven by one motor, but at no time was the constant-potential multiple-operator type of generator used. The single-operator equipment has given excellent service since its installation, and many of these units are still in successful operation, notwithstanding that a.c. units have been substituted for d.c. for many operations, as will be explained later.

It was felt at the outset that the a.c. welding transformer could certainly be counted on to eliminate, at least to a large extent, the troublesome d.c. ailment—magnetic blow. It was not expected, however, that it would be a panacea for all welding troubles, as claimed at the time by some proponents of the a.c. system. In addition to the elimination of all d.c. troubles, it was also claimed that the melting rate of the electrode would be materially increased over that obtained with d.c. for the same kva. input; that the deposited metal would be sounder, owing to the puddling action of the alternation of the current on the molten metal; that the tensile strength and the ductility of the deposited metal would be higher than that obtainable with d.c. equipment; that it would be almost impossible to produce a weld with undercut and unfused areas; that penetration would be better, *ad infinitum*. Such statements were looked upon by the management and engineers of the Kellogg company with considerable skepticism. Of course, all the authorities on the subject did not agree on all these claims, but for the benefit of those welding concerns who are considering the use of a.c. welding,



One of Two Reaction Chambers With 4⅞-In.-Thick Walls, Recently Welded by the Kellogg Company, Using A.C. Equipment.
(Two similar chambers were welded about a year ago with D.C. equipment. The results were practically identical.)

and who have heard such claims, they are repeated here.

The first move of the Kellogg company was to purchase two 750-ampere welding transformers with external reactance. These were bought from one of the leading manufacturers of welding equipment in this country. Tests were conducted for months on test plates approximately the size of those required by the A.S.M.E. Unfired Pressure Vessel Code for Class 1 pressure vessels. Welds were made on plates of various thicknesses between normally accepted commercial limits. Thorough x-ray examination, as well as the usual physical tests, chemical analyses, microscopic and macroscopic examinations, were made on each plate. Several commercial electrodes and some of our own manufacture were tried.

Magnetic Blow Is Almost Altogether Eliminated

On completion of the above tests, one thing was definitely known—namely, that magnetic blow had been practically eliminated. On account of this fact, and certain other more or less encouraging indications, it was decided to purchase one more 750-ampere and one 400-ampere welding transformer. These were bought from another manufacturer so that they could be compared directly in operation with those already purchased. It was decided to proceed with further welding tests, but in this case on full-sized cylindrical sections, making both circumferential and longitudinal welds, as well as manway welds. At the completion of these tests, the Kellogg company felt assured that a.c. equipment could make pressure-vessel welds having mechanical properties equal to those made by d.c., and that the welds could be made with less trouble, on account of the elimination of magnetic blow.

It was, therefore, decided to apply this type of welding to regular production work, at which time two more 750-ampere transformers were ordered from a third manufacturer for comparative purposes.

Since that time, additional units have been installed, and a large tonnage of pressure vessels has been welded with this process. Although most of the welding in the Kellogg shop is being done with a.c. equipment, a very large amount is still being done satisfactorily with d.c. equipment.

Effect of Electrode Coating on A.C. and on D.C.

During the investigation, one very interesting—and, it is felt, important—fact was discovered. This concerns the effect of weldrod coating composition on the properties of the deposited weld metal—(1) with a.c., and (2) with d.c. It was noted, in using certain commercial rods with a.c., that the welds were sounder and the physical properties better than when using the same rods with d.c. It was also noted in some cases that the reverse of this was true. This was also found to be true with some of the rods coated by the Kellogg company. Some rods seemed to spatter more with a.c. than with d.c., and *vice versa*.

A thorough investigation of this phase of the work was taken in hand, using rods made by the Kellogg company so that the effect of the elements and compounds which make up the various coatings could be determined. After a considerable amount of testing, it was noted that certain elements or compounds in the coating would cause a great deal of spatter during welding, or result in porosity in the weld, or both, when using a.c., while no trouble would be experienced when using these same rods with d.c. The reverse of this was found to be true when using certain other elements or compounds in the weldrod coating. With these data to work with, the next step was to develop a coating with just the correct proportion of each of these materials in it, so that the bad effects of some materials while welding with a.c., for instance, would be neutralized by the good effect of certain other materials while welding with a.c., and *vice versa* when using d.c. Unfortunately, this is more easily said than done. It, however, is not impossible, because such a coating has been developed and is now in use, and is giving quite satisfactory results when used on either a.c. or d.c. equipment. It must not be construed that such a rod is essential. A good a.c. rod and a good d.c. rod may be chosen and production proceed with these two rods, but in a shop where both types of equipment are used extensively, it is naturally much more convenient to have a single coating good for both types of current, if possible.

The welding engineer is naturally interested in a comparison of a.c. and d.c. equipment on the basis of their mechanical and electrical characteristics.

A.C. Equipment Has No Advantage in Weight and Size

For a given kilowatt output, an a.c. welding transformer is usually heavier and a little more bulky than a d.c. motor-generator set. For portable sets, the latter would probably be more desirable. A.c. equipment, however, has no moving parts, except in a recently announced polyphase motor-alternator set, and in one make where a fan is used for cooling. The other makes are usually air-cooled by natural ventilation. Because of the absence of moving parts, with their consequent maintenance cost, the a.c. equipment is preferred from a mechanical standpoint.

The control and ease of adjustment of the welding current is naturally a very important feature of any welding set. It is felt, therefore, that a brief description here of some of the different types of controls furnished on a.c. transformers would not be out of place. Of the three makes of a.c. equipment purchased by the Kellogg company, one employs a self-contained movable-core reactance; one a combination plugging and movable-core system; while the third manufacturer has supplied two types—one with a separate-reactor unit with a movable core, and the other with reactor-winding tap-changing knife switches.

Some Units Allow a Closer Adjustment Than Others

Of the four types, the variable external reactance and the movable-core type, each of which is actuated by a screw, are preferred by the Kellogg company because of the more accurate adjustment afforded by these devices. Between the two, the former is felt to be the more desirable, if for no other reason than the lack of noise as compared with the latter. (It is understood that machines of the latter type are now being built in which the noise has been eliminated.) The movable-core type is somewhat more compact than the external-reactance type. Perhaps there is no real choice between these two pieces of equipment.

In the case of d.c. equipment, the experience of the Kellogg company has been entirely with the individual type of so-called constant-current generator. For this type of machine, whether the reactance be external or built into the generator, the current control is usually obtained by the use of a field rheostat. It is felt that this control is equally as good as any one of those furnished on the a.c. equipment.

High A.C. Open-Circuit Voltage Presents Hazard to Operator

Electrically, each type of current seems to have advantages as well as disadvantages. The open-circuit voltage of 110 volts, which is customary on most a.c. welding transformers, is less desirable than the usual lower d.c. open-circuit voltage of from 60 to 75 volts, since the high open-circuit voltage is not only a discomfort to the welder, knowing that he may be shocked, but really constitutes a danger inasmuch as it may cause the welder to slip or fall from some high position should he by any chance receive a shock while changing electrodes, or at any other time when he is not actually welding. While this particular disadvantage may be overcome by the insertion of a suitable system of relays or other expedients in the circuit to reduce the open-circuit voltage, this is likely to make the establishment of the arc somewhat sluggish, to say nothing of the relatively large

initial cost of this equipment and consequent maintenance cost.

Seriousness of Unbalanced Phases Depends on Capacity of Line

All a.c. welding transformers are naturally of the single-phase type. Therefore, when such a transformer is connected on to a 2-phase or 3-phase line, the circuit is immediately unbalanced. Such a condition is of no particular consequence when the capacity of the transformer is small compared to that of the line; but when the reverse is true, serious trouble may result. Where several transformers are in use, this trouble may be partly overcome by connecting an equal number of transformers to each leg of the circuit. This trouble is not encountered when using d.c. equipment, since the generator is usually driven by either a d.c. or polyphase motor, or even by a gasoline engine.

Where welding is to be done in remote places, such as in the field, the a.c. transformer is precluded because of the absence of a primary-current supply, unless, of course, a separate gasoline-motor-driven a.c. generator is used for this purpose.

Welding transformers, when designed for high efficiency, usually have a very low power factor, and when designed for a high power factor, have a very low efficiency. It would not be economical to use the latter type where a great deal of welding is being done, but yet a large number of low-power-factor transformers on the line might well prove expensive if the welding shop draws its current from a source where a penalty is placed on a low-power-factor load. In the latter case, one or more synchronous condensers might be installed to correct the low-power-factor load.

Omitting Condensers, A.C. May Have Slight Advantage in Cost

This brings up the question of cost. The present price for an a.c. welding transformer with reactance is about the same, or perhaps a little less, than the price of d.c. equipment of the same capacity. This does not, however, tell the whole story, since the additional cost of the necessary equipment for reducing the open-circuit voltage, as well as the cost of the synchronous condensers where required, should be included. It is felt that when these are included, the cost of a.c. equipment will probably be higher than the cost of d.c. equipment of the same capacity. How long this will be the case, is not known. It does not seem reasonable to believe that such simple equipment as a.c. transformers should cost as much as the more complicated motor-generator sets used for d.c. welding. Perhaps some day an a.c. generator will be built capable of supplying current having the proper characteristics for welding. When this is done, it is quite probable that the cost of such a machine will be comparable to that of a d.c. welding set. Some of the disadvantages outlined above, such as lack of portability, etc., would be overcome by such a machine.

Circuit Characteristics Do Not Respond the Same as With D.C.

In using a.c. welding equipment, the welding-shop foreman must learn to think of resistance and other factors in slightly different terms from those he has been accustomed to when handling d.c. welders. A given increase in resistance of the welding cables, for instance, causes a great deal more difference in the welding current supply than is the case in d.c. welding. The efficiency of the welding transformer is largely dependent upon the open-circuit voltage. The power factor is also dependent upon the open-circuit voltage. Change in welding current due to change in arc length is a great deal different between a.c. welding and d.c. welding. In a paper entitled "Alternating Current Arc-Welding Transformer and Circuit Characteristics," which appeared in the September, 1934, issue of *The Welding Journal*, A. M. Candy, of the Westinghouse Electric & Manufacturing Co., very ably explains these and other characteristics of a.c. welding equipment.

Purdue Conference Sets Record for Enrollment

With a registration of 385, a new record was set at the Purdue University welding conference, held Dec. 13th and 14th. Intense interest was shown in the papers program, and many manufacturers and distributors had exhibits and demonstrations in the shops, showing the application of welding, brazing and flame cutting. The program was in charge of W. A. Knapp, professor in charge of the Engineering Extension Department, and J. D. Hoffman, head of the Department of Practical Mechanics.

Talks on Application of Welding to Dies

"Arc Welding in the Fabrication and Maintenance of Dies" was the subject of a lecture by J. F. Lincoln, president of The Lincoln Electric Co., Cleveland, Ohio, given before a joint meeting of the Detroit Section of the American Welding Society and The Industrial Electrical Engineering Society, at the Fort Shelby Hotel, Detroit, Mich., on the evening of Dec. 5th. Motion pictures and lantern slides were shown. Comparisons of American welding practice with that in Europe, South America and Japan, were brought out by the speaker.

Texas Welding Conference Set for February

The welding conference at the Texas Technological College, Lubbock, Texas, has been set for Feb. 14th and 15th, according to word received from J. C. Hardgrave, of the Department of Mechanical Engineering.

The program of the conference to be held at Iowa State College, Ames, Iowa, Jan. 23rd to 25th, is not yet prepared, but will be announced in the January issue of *The Welding Engineer*.

Philip Kearny Elected President of I. A. A.

A new record for attendance at the technical sessions was established by the International Acetylene Association at their 35th annual convention, held at the Wm. Penn Hotel, Pittsburgh, on Nov. 14th to 16th. The total registration was 755.

Philip Kearny, president of the K-G Welding & Cutting Co., was elected as president for the coming year, succeeding H. B. Pearson, of Compressed Industrial Gases. The new vice-president is C. O. Epperson, vice-president of National Cylinder Gas Co., Chicago, and formerly director of the Association.

Philip Kearny, I. A. A. President.

H. F. Reinhard was reelected secretary. The new treasurer is Henry Booth, sales manager of the Shawinigan Products Corp., New York. The following directors were elected for three years: G. B. Walker, The Linde Air Products Co.; L. F. Loutrel, Shawinigan Products Corp.; and H. B. Pearson, retiring president of the Association. H. B. Dalisie, of the Canadian Liquid Air Co., Ltd., Montreal, Canada, was appointed director for two years to fill the unexpired term of C. O. Epperson, who was elected vice-president of the Association.

The convention closed with a banquet on Friday night, Nov. 16th, which was attended by over 225.

Effect of Design and of Operation *on the* Power Factor of Resistance Welders

■ By P. W. FASSLER

President, P. W. Fassler & Co., and Consulting Welding Engineer

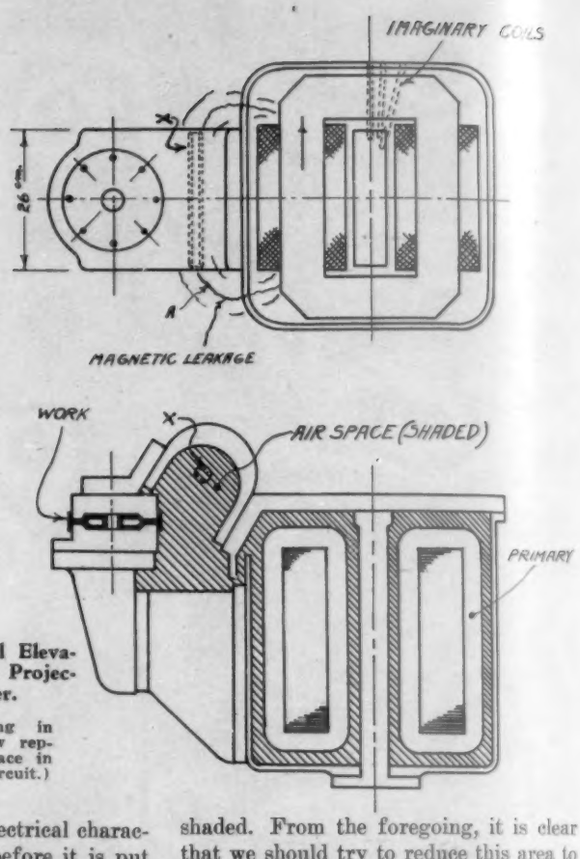


Fig. 1. Plan and Elevation of 300-Kva. Projection Welder.

(The shading in the lower view represents air space in the magnetic circuit.)

THOUGH treated in highly theoretical books shunned by many practical men, "power factor" creeps unannounced into every-day resistance welding applications, sometimes with disastrous results.

In his capacity as consulting engineer, the writer has often had no recourse other than to recommend that a machine of higher capacity be obtained to perform a certain job, even though the tag on the machine in use showed an apparently sufficient kva. rating and comparatively high secondary voltage. The trouble was that most of the voltage was being used to overcome the reactance of the various undesirable magnetic fields set up in the machine, leaving an insufficient amount to do the actual heating necessary to produce a weld. In other words, the machine operated with a bad power factor.

Power Factor Affects Machine Capacity, Irrespective of Rating

It is, therefore, unfair to compare welding machines merely by their kva. rating, without considering the power factor. The welding-machine user should have some idea as to the expected power factor in order to plan his production intelligently according to the available machines. This will prevent costly delays afterwards, for little or nothing can be done once a machine is built and put in operation. The power supply is also of great importance, and the plant electrician has a right to know something about the power factor of a certain machine so he can determine the total power factor in the plant.

While we admit that a high power factor is not likely to be obtained where a great number of large welding spots are required, the welding-machine user nevertheless should know the electrical characteristics of the machine before it is put into operation, and not afterwards. This statement is, of course, not meant to justify the building of welding machines that will, under all conditions, operate with a low power factor.

Fortunately, the welding-machine designer is in a position to create machines in which the reactance is reduced to a low figure. Magnetic flux, while hard to express in formulas, is well defined, and the electrical characteristics are not entirely problematical.

For our own work, we developed a method which is based upon the conventional method of figuring reactance of power transformers, but it is not our aim to develop formulas in this article. We had rather restrict ourselves to a discussion of the general principles involved.

Calculations Made for 300-Kva. Welder

On a recently designed 300-kva. projection welding machine, some investigation was done in this respect. Diagrams of this welder are shown in Fig. 1. In addition to the main flux in the iron core, there obviously will be a certain leakage flux flooding the windings in the opposite direction at *A*, thereby inducing an opposing voltage.

We recall that the magnetic flux obeys laws similar to the electric current and will be in proportion to the area of the air space and in inverse proportion to its length.

In the lower diagram in Fig. 1, the area of the involved air space is shown shaded. From the foregoing, it is clear that we should try to reduce this area to the minimum and increase the depth by making the coils as long and thin as practicable. This, of course, also applies to the leads, which for the same reason should be made as wide as possible and consequently reduced in thickness.

The welding engineer, therefore, like the architect, is not satisfied to apply his construction materials in a haphazard manner, but has to consider the correct relation between thickness and width from an electrical point of view.

So far only air space has been considered, but the introduction of the iron of the work will increase the leakage flux considerably by reducing the magnetic resistance (reluctance) and thereby increasing the reactance.

Another important factor is the construction of the transformer, in which we are guided by the fact that the reactance is attributed to three different sources, namely: the reactance of the primary, the reactance of the secondary, and the mutual reactance of both.

Transformer Housing Serves as Secondary Winding

The transformer illustrated in Fig. 1 has no iron housing, but a housing made of non-ferrous material, which at the same time serves as a secondary winding. Such a winding can be considered as composed of an infinite number of parallel coils. The secondary is therefore like a ring solenoid, and its inductance is reduced by the increase of length through circular arrangement. The mutual induc-

tance is also reduced, as only a certain proportion of secondary coils can react upon the primary.

It is high time to remove all guess work from the welding-machine industry. The structural designer is not guessing when he determines the span of a bridge; neither is the electrical engineer in designing a turbo-generator. They all make their deductions from certain given facts. The facts pertaining to welding-machine design are just as clear-cut. Why should it not be possible to determine the reactance of a welding machine from the area of the air space between current-carrying members and the dimensions of the work? While the engineer is interested in predetermining the characteristics, the consumer wants to see results. Therefore, every welding-shop executive should know what his machines can do in these days of the oscillograph.

Determining the Characteristics of the Circuit

The interpretation of the facts once obtained is as simple as the triangles of our illustration. On our 300-kva. machine, we obtained a power factor or cos.ϕ of 0.54, which corresponds to an angle of 57°. The secondary open-circuit voltage was 5 volts, and the secondary amperage 60,000. The resistance of the transformer, the leads and the joints, was 0.0000135 ohm.

According to Ohm's Law, as applied to alternating current, the voltage equals the impedance times the amperes. The impedance is, therefore:

$$\frac{5}{60{,}000} = 0.000083 \text{ ohm.}$$

We also know that the impedance is equal to the geometrical sum of the resistance and the reactance. Therefore, we

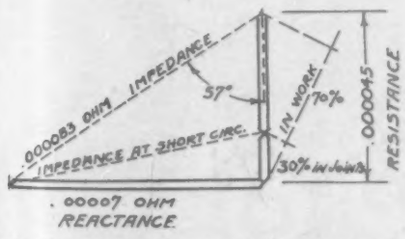


Fig. 2. Graphical Solution for Resistance and Reactance of Welder Circuit.

are given two angles (57° and 90°) and one side of a triangle and, hence, are able to construct the triangle, as in Fig. 2.

From this triangle, we obtain the following values. Reactance = 0.00007 ohm. Resistance of the work = 0.000045 — 0.0000135 = 0.0000315 ohm, or 70% of the total.

The impedance at short circuit, which is also indicated in the illustration, is of the greatest importance, because it allows us to calculate the maximum current at a given voltage according to the abovementioned relation known as Ohm's Law.

The corresponding voltage vector diagram, shown in Fig. 3, indicates that even this machine, with a high power factor of 0.54, has a relatively high voltage drop from 5 volts to 2.7 volts. This voltage is further reduced by 30%, or 0.8 volt, through the joints in the contact spring, arms, etc., and only 70% is applied at the work. The influence of the work cannot be corrected, but the resistance in the

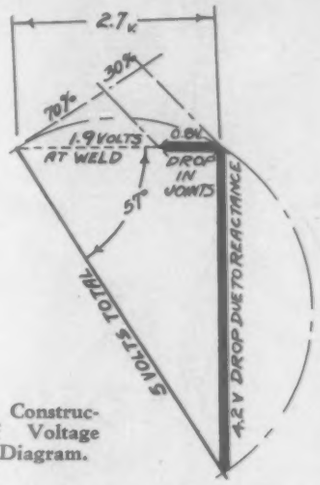


Fig. 3. Construction of Voltage Vector Diagram.

joints can be reduced through careful designing. These joints should be as large as possible, and they should be tinned in order to obtain a good contact.

Inserting Iron in the Air Space Changes the Characteristics

If we insert into the air space of the machine an iron tubing of 1-in. diameter, with ¼-in. wall, and 10 in. (26 cm.) long (indicated by *X* in Fig. 1), this multiplies the theoretical air space many times, as each unit area of this material represents approximately one thousand units of air space, the exact relationship depending on the permeability of the iron. Now we notice at once a drop in secondary voltage and a reduction of the power factor.

We analyzed these results on the same 300-kva. machine for a condition shown in Fig. 4, and found that by introducing a different welding job with more iron, which represents the aforementioned tubing, between the electrodes, the power factor dropped from 0.54 to 0.36. Consequently, the secondary voltage had to

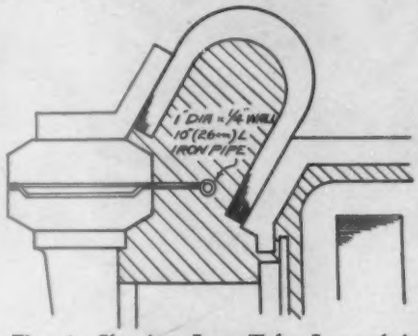


Fig. 4. Showing Iron Tube Inserted in Air Space of Welder.

be increased from 5 to 7.4 volts to overcome the additional reactance. This indicates that the welding-machine designer has to deal with a problem such as this very carefully, to avoid trouble later on. In this connection, it should be understood that an iron housing around a transformer will have an effect on the magnetic flux which most certainly will be responsible for additional reactance.

Research work in this respect most certainly would lead to interesting conclusions. It is hoped that this discussion will inspire the resistance-welding industry to additional progress in design and assist the welding-machine user in making an intelligent selection of his equipment.

Accumulates Large Pile of Trade-In Junk

During approximately the past two years, a large pile of obsolete welding and cutting equipment accepted as trade-in against the purchase of new apparatus, has been accumulated by Sam Smith, Airco's district manager in Milwaukee. The illustration shows part of Sam's "graveyard"—mute evidence of an aggressive policy toward getting the customer to turn in his antiquated apparatus requiring frequent repairs, and get new equipment. Much of the "junk" shown was leaky apparatus—costly in gas consumption and a hazard to life.

This Pile of Regulators and Other Obsolete Equipment Is Known as "Sam Smith's Graveyard."

A Comparison of

Steel and Cast Iron

For Stress-Transmitting Mechanisms

■ By EVERETT CHAPMAN
Vice-President, Lukenweld, Inc.

IT IS through welding that steel has attained the distinction of being the ideal structural material. In this synopsis of a paper read before the Annual Meeting of the American Society of Mechanical Engineers, in New York, N. Y., Dec. 4, 1934, Mr. Chapman makes clear why cast iron and steel behave as they do under stress.

COMPARISON of the observed properties of cast iron and steel, simultaneous with an examination of their physical composition, throws a great deal of light upon the applications and limitations of the two materials. When the physical properties are interpreted in terms of physical structure, additional light is thrown upon the causes of failures of gross structures and upon the reasons for differences in the strength of various ferrous materials.

Consider the physical properties of commercial gray iron as explained by the microstructure of the metal, taking into

Fig. 1. Microphotograph of Cast Iron.
(Reduced from 100 to 50 diameters in reproduction. The dark areas are graphite flakes.)

account the chemistry of the material. Fig. 1 shows a microphotograph at 100 diameters of unetched gray cast iron. It is an aggregate of pure graphite in flake form and impure steel. The graphitic flakes are pure carbon, generally in the form of shell-like plates. The steel matrix is an impure steel by commercial standards, containing relatively high amounts of sulphur, phosporus and silicon, with a moderate amount of combined carbon. Like steel, this matrix has the same modulus of elasticity, in that the number of pounds of stress per unit deformation has the same value as that of the open-hearth product—namely, 30,000,000. The nature of the bond between the graphite and the steel in this physical aggregate is not known exactly, but it is undoubtedly poor as far as the transmission of any tensile stress is concerned. No bond is needed for the transmission of a compressive stress, since the graphite flake perfectly fits its mating void and the bearing area between the two is fully developed.

Discontinuities in Matrix Cause Stress Concentrations

Fig. 2 shows the stress distribution that exists in an elastic matrix similar to that of cast iron. It is a photograph of a piece of celluloid supporting a tensile load, taken under polarized light. In the celluloid, random shapes have been cut in a random distribution to simulate the location and shape of the graphitic flakes as they occur in cast iron. If we assume that there is no bond between the graphite and the steel, this analogy is exact in the case of a piece of cast iron used for the transmission of a tensile stress. In compression, the analogy would be correct only if the holes were filled with a material that had a lower elastic modulus than the celluloid. Rubber would be such a material.

The photograph indicates that in such a configuration there is a tremendous variation of stress from point to point in the matrix. Many stress concentrations exist whose magnitude is from eight to ten times the values that exist at other points. These high stress values are present at the ends of the voids and are due to the fact that ripping actions occur at the ends of those sharp-pointed flakes existing at right angles to the stress. With such widely divergent stress values introduced by the presence of the graphitic flakes, it is interesting to note that the average stress, as calculated by dividing the applied load by the cross-sectional area, has very little meaning. The practice of working cast iron at as low a tension stress as has been proved necessary simply insures that the point of maximum stress is below the safe working limit for the material of the matrix.

It is obvious that a material with such incipient rips throughout its body will have poor tensile properties. The same material under compression will show

Fig. 2. Celluloid Specimen Cut to Simulate Cast-Iron Matrix, Examined Under Polarized Light.

much better properties if the severity of the incipient rips has in some manner been lessened. Impact values, which express the tenacity involved in an energy-absorbing, ripping type of failure, are obviously lowered in a material where the energy is absorbed at these few points of high stress rather than over a uniformly stressed cross-section. The fatigue characteristics of a material are a function of the material itself, but they are also tremendously influenced by the points of high stress introduced in one manner or another. In a material in which the spread between maximum stress and minimum stress is as great as it is in cast

iron, the fatigue values are much lower than those that would be exhibited by the matrix itself in a homogeneous form. It is interesting to note the relative insensitivity of cast iron to further notch effects. Highly refined steels, when properly treated, show tremendously high fatigue values when compared to cast iron; but in contrast to cast iron, such steels must be fabricated with extreme care because their sensitivity to surface finish is great. Cast iron, with its myriad of notches al-

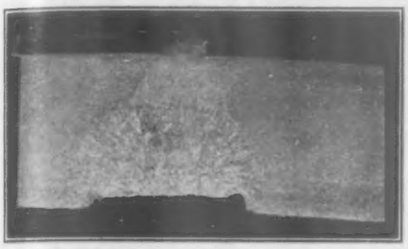


Fig. 3. Under-Cutting at the Edges and Drippings at the Root of This Weld Introduce High Local Stresses.

ready existing inherently, does not show the effect of one more point of high stress if it is introduced in the design.

Cast iron has a modulus of elasticity of 12,000,000 in contrast to the modulus of 30,000,000 shown by steel, a more homogeneous material of the same chemical composition as the matrix of cast iron. This low modulus, together with the fact that it varies with the stress, is again a result of the extremely heterogeneous stress condition, as already shown in Fig. 2. As a load is applied to cast iron, the material deforms elastically at some point and may deform plastically at other points. This combination of elastic and plastic action is the mechanism operating to give the low modulus of elasticity in cast iron. It also explains the fact that the modulus actually drops as the stress increases.

Explains Behavior of Cast Iron Under Repeated Loading

That plastic action at the points of high stress occurs early in the loading cycle, explains why cast iron takes a permanent set at low values of stress. This fact, and the falling off of the value of modulus of elasticity at low load, is indicative of the presence of terrific local concentrations of stress. The stress introduced by the smallest load is multiplied locally to values over the elastic limit by the discontinuities present.

Cast iron grows under repeated heating and cooling to a far greater degree than steel, because as the material expands under heat, the highly stressed points at the ends of the graphitic flakes are elevated over their elastic limit by the adjacent expanding material. When the iron cools down, these highly stressed points are permanently deformed in contrast to the points of low stress, and the material exhibits the phenomenon of a body assuming a size larger than it was originally.

Any sort of structure that is subjected to a load will, at a point of severe change in contour, exhibit poor tensile, fatigue, impact and related properties. In view of the type of elastic discontinuities that exist in a riveted structure, for example, it is no wonder that the smooth-flowing welded structure, with its uniform butt joints and carefully faired intersections, offers all the rigidity, energy-absorbing abilities and high fatigue values that are inherently guaranteed by its high degree of elastic homogeneity.

Spherical Voids Give Malleable Iron Better Properties

The shape of internal voids and surface defects has a tremendous influence on the mechanical properties. Malleable iron, in which the graphite is in spherical form, has much better properties than gray iron of identical chemical composition. The stress concentration which is introduced by a spherical void is theoretically equal to 2.7 times the magnitude of the average stress, whereas the intensity of stress introduced at the ends of one of the sharp-cornered graphite flakes in cast iron may be of the order of magnitude of ten times the average stress.

Modern electric-furnace cast iron that has been superheated has finely divided graphite flakes instead of the coarse flakes found in the cupola product, and all the physical properties of such modern iron—even the modulus of elasticity—increase in the same ratio as the maximum stress is brought more into line with the average stress by this re-distribution of the graphite.

Why Wrought Iron Is Stronger in One Direction Than Another

In wrought iron, the pure ferrite matrix is riddled with long slag streamers that have a most decided orientation along the length of the plate as it was rolled. When the stress is parallel to these streamers, the elastic behavior is four or five times as good as it is when the stress is at right angles to the slag inclusions, since a load at right angles to the slag inclusions is in the direction to exercise the maximum ripping effect in the ferrite at the ends of the slag voids. The maximum stress in the material is much greater for a transverse pull than it is for a longitudinal pull.

The possibility that the average stress equals the maximum stress in an ideal material leads to some interesting conjectures on the possible strengths of materials. Steel is by no means the pure, homogeneous material that it is usually visualized. If graphite distributed at random can so vitiate the known properties of the steel matrix in cast iron, what strengths would steel exhibit if it in turn were rid of the minute impurities, minute internal checks and internal strains known to exist in the commercial product? The cohesive forces between the atoms making up a material are a measure of its theoretical strength.

Truly Homogeneous Steel Would Have Tenfold Greater Strength

The atomic bond in pure iron, as theoretically deduced from its latent heat of vaporization, indicates that the strength of steel should be about ten times the observed values in ordinary commercial steel. The difference between the observed values and the theoretical values can be reasonably supposed to be due to stress-raising, non-metallic impurities, minute internal cracks resulting from cooling, and internal strains distributed at random that pre-load the material from point to point. Is it not reasonable to conceive that the known strengths of materials and structures are the difference between the theoretical strengths of the atomic bonds and the damage done by such minute phenomena as notches, non-metallic impurities, distributed graphite, screw threads, unfused roots of welds, sharp fillets and all such forms of discontinuities?

Modern weld metal is a freak. Its properties seem to give a clue to what might be expected from theoretically clean materials. It is perfectly possible

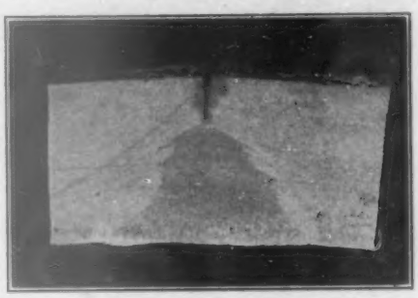


Fig. 4. Lack of Penetration Has Greatly Reduced the Working Strength of This Joint.

to produce in the electric arc, in the form of weld metal, a steel with carbon content of 0.08%, tensile strength of 65,000 lb. per sq. in., and an elongation of 35% in 2 in. These properties, furthermore, are shown in the cast condition, and material of the same analysis made in the open hearth by modern steel-making practices will not begin to show, in any respect, the physical properties of the weld metal. The essential difference seems to be: first, the treatment of minute drops of metal; second, the use of well-designed slag; third, exclusion of the atmosphere; and fourth, temperatures much higher than can be obtained in the open hearth. The resulting metal is much cleaner than commercial open-hearth steel, and it is not a coincidence that its

physical properties are superior to open-hearth steel of equivalent chemistry.

The commercial existence of such a metal, together with the fact that it can be used to integrate rolled steel, has several important implications for the designer of structures and the makers of steel. The freedom of welded design inherently implies the ideal structure, with its smooth-flowing contours and its homogeneous, elastic properties. That such material as modern weld metal can be produced is an incentive to both the maker of steel and the designer of structures to reduce, perhaps eliminate, the number of damaging discontinuities in their steels and their structures. Without investigating the feelings, mathematical treatments and experimental methods that distinguish the master designer, it

Fig. 5. This Weld, Made from Both Sides, Shows Porosity and Lack of Penetration.

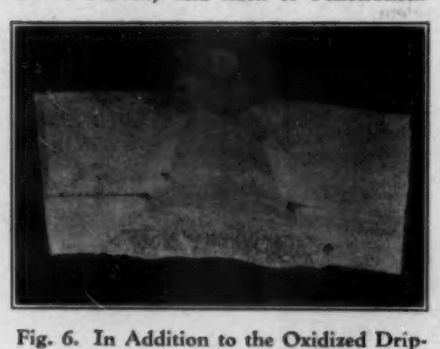


Fig. 6. In Addition to the Oxidized Drippings of Metal at the Root, This Weld Also Shows the Presence of Gases.

may be pertinent to illustrate some of the abuses of welded joints that tremendously detract from the efficiency of a welded structure.

Under-Cutting Reduces Capacity to Carry Load

Fig. 3 pictures an etched cross-section of a poorly made weld. It has been severely under-cut at one edge. The maximum stress that exists at the root of the under-cut is the stress that determines the important structural properties of the joint. The efforts of the steel-maker to produce a good steel, the efforts of the electrode manufacturer to produce good electrodes, and the careful work of the designer to produce an ideal structure, have been completely nullified by the presence of the under-cut. Moreover, the drippings of hot metal in the far side are not only badly oxidized, because they lacked the protection of the arc vapors and slag, but they also form a discontinuous projection which will introduce a high root stress. The designer's factor of safety covering this joint will have to be great enough to reduce to a safe value either the stress at the root of the under-cut or the stress at the root of the oxidized projection, taking into account the damaged metallurgical condition of the drips. Whenever such examples of welding are found, they will entirely discredit the use of weld metal.

Fig. 4 is an example of a weld that has not completely penetrated to the far side. The incipient rip, introduced by the unfused root, reduces the working strength of such a joint by at least six times.

Fig. 5 shows a welded joint made from both sides, in which the workmanship was such that neither the weld metal nor the steel has an opportunity to perform as a homogeneous, elastic entity. The fusion at the root of the weld is incomplete, introducing a void at right angles to the applied load, which not only resulted in failure, but the perfection of the weld metal has been entirely nullified by the porosity present. The porosity was due to the fact that the electrodes were not used at their proper current density.

Presence of Gas-Forming Impurities Causes Porosity

Fig. 6 illustrates a welded joint in which a combination of troubles are present. The weld has been attempted entirely from one side, which results in the usual oxidized projection of metal on the far side. In addition, the steel itself was not properly adapted for ideal welding. It exhibits a layer of gas-forming impurities which, under the heat of the arc, produce great volumes of gas, generally in such large quantities that the electrode, with its normal boiling action, could not eliminate them. This joint again illustrates the abuse of material with excellent physical properties in conjunction with a parent metal that is not the equal of the material used for joining.

It is possible to make a good weld on poor parent metal if the proper technique is observed. Fig. 7 shows a sound, homogeneous weld made on a parent steel of poor welding properties. The parent metal exhibits several banded zones or laminations containing non-metallic impurities which, under the heat of the arc, will give rise to volumes of gas, some of which will be entrapped.

Fig. 8 demonstrates what can be expected today in a welded joint when the proper steel specifications and welding technique are observed. The joint as a whole presents very little change in either external or internal contour. The stress condition over such a joint would be extremely uniform; there are no points of maximum stress of any magnitude. The metallurgical discontinuities that exist in such a joint, due to the thermal abuse of the arc, form different subject matter which can, however, be corrected to produce complete homogeneity.

With the welding technique and the parent-metal specification definitely

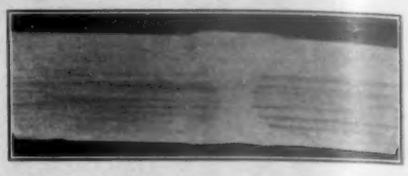


Fig. 7. Good, Homogeneous Weld Made on Poor Parent Steel.

Fig. 8. This Perfect Joint Will Transmit Stresses Uniformly Throughout Its Section.

known for the production of the type of joint illustrated in Fig. 8, it remains for the designer to evolve the ideal structure to meet the mechanical demands imposed by his problem.

Application of Steel as an Ideal Elastic Material

Fig. 9 illustrates a welded steel frame for a 2000-ton hydraulic press. Although a load of 2000 tons is working on the steel side members of this frame, a flat

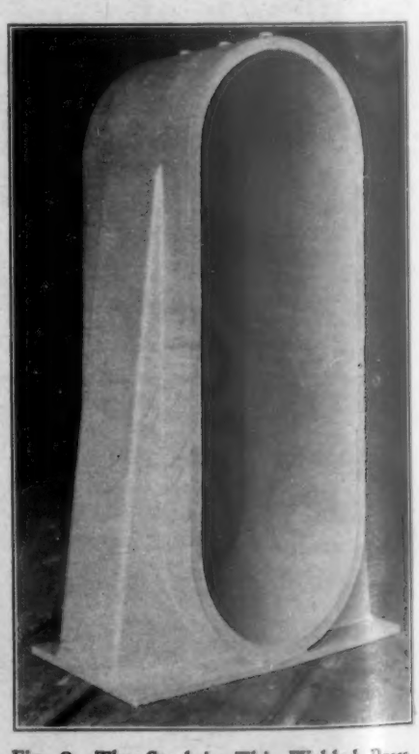


Fig. 9. The Steel in This Welded Press Frame Is Subjected Only to Tension.

butt joint, properly made, gives the ideal type of joint contour. The parent metal was carefully specified; fusion at the root of the weld was absolutely insured by chipping out the back of the first bead; the contours of the finished bead were carefully ground where they presented any discontinuities, and the entire frame was heat-treated to restore those physical properties that suffered because of the welding heat. The design of the press frame is such that the steel is used in pure tension, which is the ideal use for any homogeneous material, while the mechanical requirements of distributing the load from the bottom of the hydraulic cylinder to the steel hoop were met by the use of semi-circular slugs of cast iron in compression, as shown in position in the frame in Fig. 10. Here again, utility and

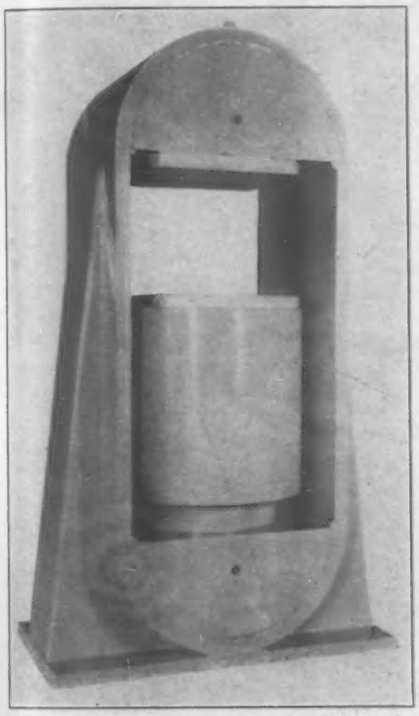


Fig. 10. Semi-Circular Castings Transmit the Loads to the Steel Frame.

economy dictated the use of cast iron because it shows desirable properties in compression, and that, together with its low cost, made it an ideal material for this application.

Such a construction as this minimizes the curvilinear type of deflection that usually occurs in press platens. The curvilinear type of deflection is extremely hard on dies or other equipment that depends for support on the rigidity of the platens. The only type of deflection of which this press is capable is a straight tension elongation of the side members, which is an elastic motion parallel to the motion of the hydraulic cylinders and therefore does not affect die alignment.

By using selected specified steel of known and homogeneous characteristics and using welding technique with governing specifications guaranteeing the solidity and homogeneous elastic nature of the joint, together with the selection of a type of welded joint which does not incorporate internal discontinuities, and with proper supervision to insure compliance with the approved technique, such a structure may be designed for a working stress of a value that is 75% of the yield stress of the steel. This is a factor of safety of three-quarters, based on the yield point. The uncertainty involved in not working the steel at the yield point is due to mechanical considerations of possible overloads. Since this structure has no incipient rips of the usual order of magnitude, and the deflection is of such a type as not to be detrimental to the operation of the machine, there is no reason why the material should not be worked at a stress that is just under the yield strength of the steel. Any attempts to work it over the yield strength of the steel will, of course, result in a plastic deformation each time the load is applied.

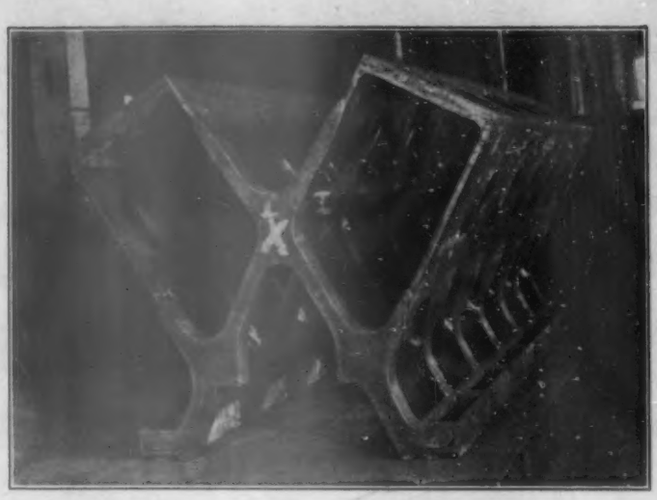


Fig. 11. This Main Frame of a Diesel Engine Shows No Abrupt Changes in Contour.

Designing and Building an Engine Frame and Crankcase

Fig. 11 is another example of a structure produced by welding in which the maximum effort was exerted to eliminate all internal and external discontinuities and severe changes in contour. It shows the main-load supporting element for a Diesel-engine frame, in which the requirement of light weight is combined with the necessity of sustaining, over a service life of many thousands of hours, a load of the nature of pure impact. This is simply saying that the design must be very clean and the factor of safety must be very low in order to meet this severe duty with minimum use of material. The gas load of 38,000 lb. is applied at the bolt circle holding the cylinder head to the top deck and the reaction to the gas load occurs at the large studs that secure the main-bearing cap to the frame. The problem is further complicated by the fact that this is a V-type engine. The loads in opposite cylinders occur in different portions of space and must be transmitted to a common reaction point—namely, the crankshaft—and this means that an intersection occurs between two pieces of metal carrying tension.

In the production of the main-frame member, flame-cutting was employed in order to provide generous, easy-flowing changes of contour in the Cromansil steel at this intersection. Machining was used in order to produce a generous curve at the point of intersection of the top deck and the side sheets. It is sound practice in a structure of this character definitely

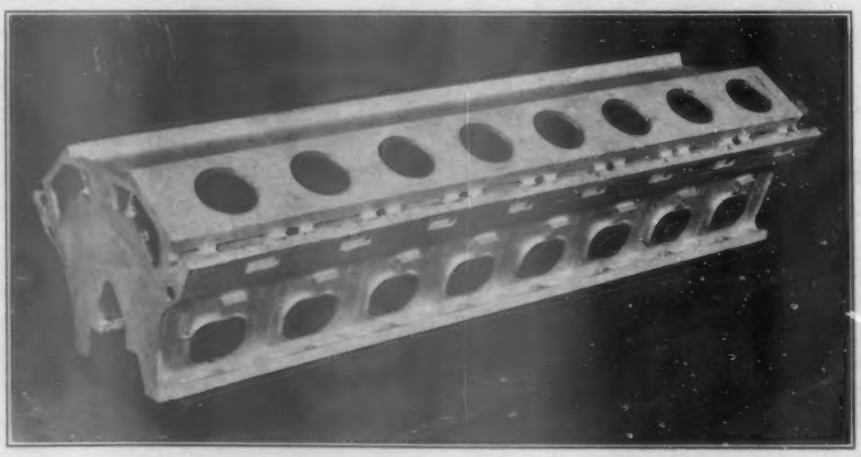


Fig. 12. In Securing Pads and Bosses to This Engine Crankcase, Care Is Taken Not to Introduce Sharp Corners.

to control these critical sections, and welding in general cannot be relied upon to produce a predictable contour in a corner. A careful technique must be specified and supervised in making the joints between the component parts in order further to insure the absence of uncontrolled boundaries, either internal or external. Once this procedure has been followed, the only limit to the lowering of the factor of safety is the residual uncertainty as to how far this process has been carried, not only in the construction of the piece but also in the actual selection of the steel entering into the structure. In the ultimate then, the strength of a structure could increase indefinitely in proportion to the cleanliness of the materials and cleanliness of the design.

Fig. 12 is a view of the completed engine crankcase with all the pads, camshaft bearings, timing-gear bosses and oil-return drains that are necessary for mechanical operation of the engine. The very requirement of the presence of these appendages to the main structure is again a hazard involving the factor of safety, since care must be taken in securing these pieces to make sure that they again do not introduce some abrupt change of contour or internal boundary on a highly stressed member.

Robert Allen Witherspoon Receives Morehead Medal

The Morehead Medal for 1933 was presented to Robert Allen Witherspoon at the opening session of the convention of the International Association, Nov. 14th, in Pittsburgh. The presentation was made by E. J. Hayden, formerly president of the Association, who in masterly style eulogized the recipient's service to the carbide and acetylene industry. Mr. Witherspoon, who is vice-president and general manager of Shawinigan Chemicals, Limited, Montreal, Canada, pioneered in the synthesis of organic chemicals from acetylene, though his greatest achievement was probably the discovery that calcium carbide could be formed in a molten condition and tapped from the furnace in dense, solid ingots, which was responsible for revolutionizing plant process and equipment.

Owens Addresses Cleveland Section on Weld Testing

The Cleveland Section of the American Welding Society had as its speaker on Dec. 12th, J. W. Owens, of the Pittsburgh Testing Laboratories, who talked on weld testing and supervision. An active campaign for members by this Section has resulted in the addition of ten in the past month.

Drama Shows How Welding Revived a Business

"Profits of Progress," an industrial drama in four acts, was presented in the Davis Theater, Pittsburgh, on the evening of Nov. 14th, under the auspices of the International Acetylene Association. There were about 2350 in the audience, and between 200 and 300 were turned away after the theater was filled. The play, written by Wilfred P. Bergland, of The Linde Air Products Co., was exceptionally well produced and thoroughly enjoyed by the audience. The plot pertained to the use of welding to bring back into popularity the products of the "Walton Engine Co.," after the firm had made the mistake of supposing that everything was all right and they could rest on their laurels.

When they were threatened with the loss of their prize account, quick action was needed. Plans for a new engine were submitted, the fabrication of which was impossible without the adoption of welding. The engine was made, it met all requirements, and resulted in much national publicity for the progressiveness of the company. The play brought out very forcibly good, constructive salesmanship on the part of the "Keystone Welding Equipment Co.," and the proper way of training an organization in the adoption of welding as a manufacturing tool.

The cast of the play consisted of individuals who are well known in the gas-welding field. They performed their roles exceptionally well.

180 Miles of Welded Cots for Army

A total of 152,000 metal cots for the U. S. Army, involving 76,000 ft. of welding, is being made by the Bunting Glider Co., Philadelphia, Pa. The welding is under the supervision of F. J. Giroux, consulting welding engineer, Long Island, N. Y. Laid end to end, these cots would make a line extending from Cleveland to Buffalo. "Blue Devil" welding electrodes, made by The Champion Rivet Co., of Cleveland, Ohio, are being used.

Offers Welding as an Accredited Subject

Welding is now offered as an accredited subject to students of the Lane Technical High School, Chicago, this being the first year that such recognition has been given the course. The course is of 5 weeks' duration, and takes up 2 hours per day, 5 days per week, making a total of 50 hours. Both arc and gas welding is taught, though only the barest fundamentals can be given. W. E. Coleman is instructor in the course. The school recently acquired 8 new P&H-Hansen arc welders and 12 Oxweld welding and one cutting unit.

Chicago Section Holds Regional Meetings

Two regional meetings were recently held by the Chicago Section of the American Society—one in South Chicago, on Nov. 30th, and the other in Milwaukee, on Dec. 14th.

The program for the South Chicago meeting was prepared by Tom Jones, welding superintendent of the Illinois Steel Co., and included a paper on the application of arc welding to heavy equipment, prepared by A. M. Candy, of the Westinghouse Electric & Manufacturing Co., and read by L. M. Gumm, of the Chicago office of that company, and after that a motion picture on the application of "Lindewelding" to cross-country pipelines, with accompanying comments by Wm. B. Browning, of the Chicago office of The Linde Air Products Co.

The meeting was opened by Walter Mathesius, assistant general superintendent of the Illinois Steel Co. Novelties included a group of songs, with guitar accompaniment, by Miss Christine Endebak, radio entertainer, and daughter of one of the welders of the Illinois Steel Co. plant, and also a 5-piece orchestra, made up of welders from the same plant.

More than 400 were in attendance, most of these being from the steel mills, though the refineries in the district also were represented. The meeting was held in the gymnasium of the South Chicago Y. M. C. A.

The Milwaukee meeting, which drew between 350 and 400, was held in the School of Engineering, 1020 N. Broadway, and was under the direction of Otto Voss, of the Allis-Chalmers Manufacturing Co., and Richard W. Sternke, of the Lakeside Bridge & Steel Co., both of whom are directors of the Chicago Section. The program was arranged by F. L. Spangler, secretary of the Chicago Section. K. L. Hansen, of the Harnischfeger Corp., presided.

A paper on the welding and fabricating of stainless-clad steel was read by W. B. Keelor, of the Ingersoll Steel & Disc Co., of Chicago, accompanied with lantern slides, which was followed by a talk on the welding of copper by the carbon-arc process, given by W. C. Swift, of The American Brass Co. Mr. Voss showed on the screen some of the work done in the Allis-Chalmers plant in West Allis in the making of welded machinery. The talks drew forth many questions. A start was made at this meeting in the organizing of a Milwaukee Section of the Society.

Get "*H. O. T.*" on Welding

■ By H. O. T. RIDLON

[This section is dedicated to Better Welding and Better Welding Shops. Suggestions and criticisms are invited.]

"Don't Leave a Cripple"

The thought for the Season: "Don't leave a cripple."

That is perhaps one of the best known of the unwritten laws of the Woods. Now that the hunting season is with us and many of us are having our share of the sport, we should remember well that law.

And we should keep it well in mind for the entire year to come—most particularly in our sales work. All of us, by the way, have a sales job to do. Either we have something tangible to sell, or we have to sell our skill and knowledge to the boss and keep him sold, or we have to sell our services to one or many. And selling is perhaps one of the most difficult professions to master. It takes a tremendous amount of thought, study, and energy. So the unwritten law of the Woods, "Don't leave a cripple," should be remembered by all of us, because one more well directed "sales shot" may allow us to "bag" our "game." Otherwise he may crawl away to die—and spoil—so he will never be of any use to any one. So know what you are shooting at, make each "sales shot" count, and "Don't leave a cripple."

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With the "Acetylenists" at Pittsburgh

Down in Pittsburgh at the International Acetylene Association Convention last month I had the pleasure of meeting many very fine representatives from all parts of this great land of ours, who made me truly proud that I was even a small part of the same industry.

Recently I was in the offices of The Welding Engineer Publishing Co. milling over some of the old Acetylene Journals (remember them?) that were published away back when. And there's a thought for some of you gents some time when you are in Chicago: run up to their offices and look over some of these old Journals, for you will be more than welcome, and I'm sure that you'll get a great kick out of them. For instance, I was looking over one when I found an invitation to the I. A. A. convention for August 5-7, 1913, which read as follows:

"Let those come now who have never come Before;
And Ye who always Come, Come as of Yore."

I think that is swell—poetic gents, those "Acetylenists," as those worthy pioneers of this great industry were called in the days when the Acetylene Journal carried no welding equipment advertising.

Don't know what you'd call the gang that were in Pittsburgh for the I. A. A. this year; unless it would be just a swell gang of regular fellows—from the "Big Shots" right on down the line.

The Keynote Address by B. C. Forbes, editor and publisher of *Forbes Magazine*, was so full of real "meat" that it was unnecessary for him to be an orator or a dramatist. . . . The report of the Oxyacetylene Committee, by G. O. Carter, chairman, was splendid, with many fine thoughts. One that impressed me particularly was: "At the present time, the oxyacetylene process is holding its own on a dollar and cents basis, or with a cost of deposited metal." . . . "The Oxyacetylene Flame Cutting of Wing Type Ingots," by L. Gerald Firth and L. B. Knox, was good and most interesting—probably because of the newness of this application. . . . John J. Crowe did a nice job in his paper, "Welds and Weld Metal." Being one of the old school, I was duly impressed that now we should say "filler material" and not "welding rod." In his paper I was also interested to note that the aircraft-industry history of welding dates back as far as 1915. . . . "Pipe Welding," by John Zink, of course was swell, for there's a guy who knows his pipe welding, plenty well. . . . E. F. Blank's paper on "Safe Practices in Oxyacetylene Welding and Cutting" really hit its mark. But why not? There's a gent that knows his subject, has the courage of his convictions, and can stand on his hind legs and tell you about it. And safety is something we can't practice too much of. . . . G. O. Hoglund is the lad who put over that splendid paper, "Gas Welding of Aluminum Tank Structures," in grand style. I could go on for hours talking about this fellow's fine attributes. He really knows what it's all about when it comes to aluminum welding. . . . "A Comparative Study of Cutting Methods as Applied to Structural Steel," by Prof. J. H. Zimmerman, was all that the name implied, and darn good. . . . "Track Welding," by George M. O'Rourke, contained much valuable information and many startling figures on rail-end welding. For instance, he states: "Since starting rail-end welding in 1921, we have reconditioned over one million joints. The cost of doing this work has steadily decreased from year to year throughout this period." Of course, Mr. O'Rourke speaks only of the work done by the railroad with which he's connected. . . . James W. Owen's paper, "Commercial Methods of Testing Welds and Welded Products and the Dependability of Such Methods" was truly enlightening. . . . D. C. Reid read a paper on "Administration Problems in Connection with the Application of the Oxyacetylene Welding and Cutting Processes in the Railroad Shop." The railroad men seem to be on their toes to take advantage of every opportunity that is presented to them to decrease their costs and increase their profits. . . . C. W. Obert's paper, "Advantages of Flame-Cut Surfaces," brought out many fine facts and was well worth while. . . . "What the Young Engineer Should Know About Welding," by Robert L. Spencer, was a good paper, but I would like to add that it would be wise for the young engineer to work very closely with his boss welder—keep up on welding facts by continual reading and the contacts made available to him through the various manufacturers of welding equipment and supplies—because he will find that many of these practical men can be a great help to him. . . . E. E. LeVan's paper, "Hard Facing," was good, as everyone is interested in this war against wear. . . . C. H. R. Howe read a fine paper, "Oxyacetylene Process in Railway Maintenance of Way Work." I repeat, these railroad papers were swell. . . . "Comparative Efficiencies of Fuel Gases for Welding and Cutting" by Dr. George E. Slottman, caused comment, but I'd rather not make any. . . . T. R. Moxley's paper, "Oxyacetylene Cutting and Welding in the Making and Marketing of Steel," was fine and very well done.

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The Thought for the New Year

The thought for the New Year: My only regret at this time is that I am unable to take all my many friends and acquaintances by the hand and look them squarely in the eye and say, "Here's to a very Merry Christmas, Mister; and most successful and Happy New Year!"; and that goes double for all of you. In speaking of the New Year, I have a thought that all of us can use to advantage if we keep it in mind throughout the coming year—it being: use your two eyes and two ears more than you do your one tongue. Bear that in mind, Son—there's food for thought in that.

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Nope, the Pump Casing Wasn't Manganese

Just got my October issue of *Fusion Facts;* and as usual it was swell. Great help and most interesting that little book, to any one who does welding. They quoted one of my stories that appeared in this "column" more than a year ago. It was part of Don Llewellyn's story "Reclaiming Dredge Pump Cases." Thanks for them kind words, my friend. You are

correct in your presumption that it was not a high-manganese casting I spoke about. It may have been low-carbon, but I have me doubts about that too. It acted more like a chrome-nickel; but maybe it wasn't that either. And again you are right about using jigs, etc., and always welding flat on jobs like that. That's fine when they are available. But a lot of welding shops don't have cranes, and such. And there are times when these jobs have to be done on the dredge, or a nearby barge, or on the river bank, while other repairs are being made. Time is very important when it costs a contractor $500 per day to have his dredge out of commission.

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The thought for the month: No depression ever killed an opportunity.

New Jersey Association Makes Progress

Rapid strides in organization have been made by the New Jersey Association of Welding Contractors, Lefcourt Building, Newark, N. J., under the leadership of their president, Charles A. Dorer, it is reported. George A. Capus, treasurer, notified the members at a recent meeting that the closing of the books for the past year showed a substantial surplus in the treasury. Plans and programs were made for the coming year. At all the general meetings for the new year, there will be speakers of authority on welding for the benefit of the members of the organization and their employees. The strength of the organization has proved a great benefit to its members, not alone in the enforcement of fair prices but also in good fellowship and educational advantages.

Talks on Flame Cutting and A. S. M. E. Code

Papers on "Flame Cutting of High-Carbon Steels" and "Welding Tours Through the A. S. M. E. Code" were high points of the meeting of the New York Section of the American Welding Society, held on the evening of Dec. 11th, in the Engineering Societies Building, 33 West 39th St. The papers were preceded with a motion picture showing the construction of the *U. S. S. Macon*. The paper on flame cutting was presented by Bradley Stoughton, consulting metallurgical engineer, and professor of metallurgy, Lehigh University. The paper on the A. S. M. E. Code was given by W. D. Halsey, assistant chief engineer, Boiler Division, The Hartford Steam Boiler Inspection & Insurance Co., and was accompanied with lantern slides.

The following subjects will be considered at future meetings: Jan. 14th, "Welded Pressure Vessel Construction"; Feb. 20th, "Boulder Dam"; March 12th, "Shipbuilding"; and May 14th, "Corrosion-Resisting Steels."

Ohio Welding Conference Announced

Feb. 28th and March 1st have been selected as the date of the Ohio Welding Conference to be held at Ohio State University at Columbus, according to word received from Prof. O. D. Rickly.

Milwaukee School to Hold Welding Exhibition

Exhibitions and demonstrations pertaining to the arc welding of ferrous and non-ferrous metals and alloys will be sponsored by the Milwaukee School of Engineering, working in conjunction with Milwaukee industries using welding, and will be held at the school, 1020 N. Broadway, on Jan. 11th and 12th.

Oxyacetylene Committee Report in Four Sections

The 1934 report of the Oxyacetylene Committee of the International Acetylene Association, presented at the annual convention of the Association, held in Pittsburgh, Nov. 14th to 16th, was prepared in four different sections, forming in all a rather complete reference work on the use of the oxyacetylene flame. Each of the four sections has been printed and bound separately for distribution.

Section I pertains to oxyacetylene cutting and gives information on torch adjustment, gas consumption, speeds, drag, the application of the process to various ferrous alloys, and flame machining.

Oxyacetylene welding and its applications are discussed in considerable detail in Section II of the report, which also includes tables on preparation and set-up of work, consumption of gas and welding rods, and speeds. Consideration is also given to standard weld tests.

Section III discusses the use of the oxyacetylene flame in such miscellaneous applications as glass-working, heat-treating, carbon burning, tire-mold burning, mold smoking, wood charring, heating for bending, metal spraying, and removing paint.

Brief synopses of codes and regulations, issued or in project, are given in Section IV, which also includes tables of specifications for ferrous and non-ferrous materials.

These reports, prepared by the Oxyacetylene Committee, of which G. O. Carter is chairman, are published by the International Acetylene Association, 30 East 42nd St., New York, N. Y.

1800 Ft. of Steel Pipe With Stainless Interior

Five-foot-diameter piping, 1800 ft. long, made of Plykrome stainless-clad steel, has been fabricated by the Cream City Boiler Co., Milwaukee, Wis., using welding equipment manufactured by the Harnischfeger Corp., of Milwaukee. This installation, which is the largest of its kind ever made, is in operation at the Milwaukee sewage-disposal plant. The front-cover illustration of this issue shows the welding of an expansion joint in this pipe.

Welding and Metal Groups Enjoy Christmas Cheer

The Los Angeles sections of the American Welding Society and the Society for Metals are joining in a holiday season's celebration by holding what they choose to call a Christmas "Hijinks," on the evening of Dec. 20th, in the Richfield Building. Refreshments will be served, and a full evening's entertainment is being provided.

The Nov. 20th meeting of the Los Angeles Section of the American Welding Society was featured by an address on "Stainless Steel: Its Welding and Manipulation and Its Place in Industry," by J. P. Morrissey, welding expert of the Crucible Steel Co., of New York. V. M. Goode, of the U. S. Naval repair ship *Medusa*, gave an interesting description of the fleet's recent cruise to the East coast, and outlined some of the welding work being done in the navy and some of the recent jobs completed by the welding department on board the *Medusa*.

Low-Temperature Brazing Will Be Meeting Topic

Brazing with low-temperature alloys, will be the subject of a talk by Alden W. Swift, of Handy & Harman, before the meeting of the Chicago Section of the American Welding Society, to be held in the Morrison Hotel, at 8:00 p.m., Dec. 28th. This will be followed by a motion picture film showing the metallic arc in black and white and also in its natural colors, as well as the actual arc viewed through various types of protective lenses. These films will be shown by Robert W. Holt, of the research laboratories of the Chicago Steel & Wire Co., and will include arcs made by low-carbon bare and shielded-arc electrodes as well as by stainless-steel electrodes. These films are the first of the kind ever produced, and are the result of several years of experimentation. They make clear some of the physical aspects of the arc and molten weld metal. The meeting will be preceded by a dinner at 6:15 o'clock.

Book Reviews

A.I.S.C. MANUAL OF STEEL CONSTRUCTION. Revised edition; 6x9 in.; 352 pages; replete with diagrams and tables. Flexible binding; price, $2.00. Published by the American Institute of Steel Construction, 200 Madison Ave., New York, N. Y.

This new (second) edition of the A.I.S.C. manual is changed as to form, size, and, to a large extent, as to type of matter included. Details and safe loads on newly revised and standardized wide-flange sections made by several mills, as well as engineering data on other standard sections, are included. Though a strictly academic classification is not adhered to, the arrangement of data provides maximum convenience for the estimator, designer and detailer, with the exception that the detailing dimensions of rolled sections, rolling-mill practice as to tolerances and surface finishes, and a few other topics, are not repeated in each case, but suitable cross reference is made.

The book is divided into five parts. In Part I are given dimensions, weights and properties of rolled steel sections and general information on bars and plates; also permissible tolerances and variations, and miscellaneous data for designing and estimating. Part II contains such data on details and weights as will be useful in preparing estimates and detail drawings. Part III gives tables of allowable loads for stipulated conditions based on the unit stresses permitted by the A.I.S.C. Specification. In Part IV are given the A.I.S.C. Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings; A.I.S.C. Code of Standard Practice; A.I.S.C. Specification for Fireproofing Structural Steel Buildings; A.S.T.M. Specifications covering steel for bridges and buildings as well as structural rivet steel; extracts from the American Welding Society Code for Fusion Welding and Gas Cutting in Building Construction; and minimum live loads allowable for use in the design of buildings, as recommended by the U. S. Department of Commerce. Part V contains data on strengths, coefficients of expansion, weights and specific gravities, warehouse live loads, design data on timber, and mathematical tables.

DILATATION ET RETRAIT EN SOUDURE AUTOGENE (Expansion and Contraction in Welding). By Marcel Piette. 5½x8½ in.; 91 pages; 113 diagrams. Paper binding; price, 12 francs. Published by Office Central de l'Acetylene et de la Soudure Autogene, 32 Boulevard de la Chapelle, Paris, France.

This book, printed in French, treats in detail of strains, breakage, warpage and other deformations caused by the heat of welding. The author classifies, explains and analyzes the phenomena of expansion and contraction, determines their consequences, and makes useful recommendations towards overcoming them. Not only the welder, but the designer as well, can profit from the author's suggestions. Many specific problems are discussed and solutions given. To those who cannot read French, the drawings alone are in many cases sufficiently clear to convey the author's recommendations.

THE MODERN COPPERSMITH. By L. A. Voss. 5x7¼ in.; 375 pages; 160 illustrations. Flexible binding; price, $5.00. Published by Edwin A. Scott Publishing Co., 45 West 45th St., New York, N. Y.

This volume treats of the coppersmithing practices as applied to copper, brass, nickel, monel metal, aluminum, and other non-ferrous metals and alloys. Beginning with a discussion of the manufacture and working of copper and other non-ferrous metals, including the effect of such working on the physical properties of the metal, the author follows with a discussion of hard and soft solders, silver solders, rods for brazing and welding, the use of fluxes, and tinning. A chapter on tools and fixtures deals with such devices as hand and power saws, hand and power hammers, planishing rollers, mandrels and heads, and swage blocks, and describes their proper uses. Several types of forges and heating torches are described, as well as torches for welding by the oxyacetylene and atomic-hydrogen processes, and for brazing. Various methods of joining, including soldering, brazing, and welding are discussed briefly, and complete chapters are devoted to such subjects as copper riveting, and sheet seaming and brazing.

With the methods of forming and joining generally covered, the author applies this practical information to the manufacture of a varnish kettle, jacket kettle, dome-shaped tops, copper expansion joints, and an air chamber, the manufacturing operations of which are described in detail. Methods of making bends and forming throats are described, followed by a discussion of the operations involved in the manufacture of a ship ventilator. A chapter is devoted to the forming and finishing of intricate shapes. Several chapters are required to cover the manufacture, fabrication and joining of copper pipe.

The final chapter on the working of various metals other than copper, discusses briefly the straightening and shaping of sheets, clamping, and joining by welding, soldering and brazing.

The chapters of this book relating to shaping and forming, with particular reference to specific types of vessels and to piping, are especially valuable. No mention is made of the "Long-Arc" method of welding copper with the carbon arc, which omission is regrettable, particularly since half of the coppersmiths in this country have adopted this process and thereby materially reduced their costs on copper work. The author also repeats, rather than corrects, the belief, which was prevalent for many years, that strong copper welds can be made only in deoxidized sheets. As a matter of fact, the coppersmiths using the "Long-Arc" process are welding ordinary commercial copper with highly satisfactory results.

RIVETING AND ARC WELDING IN SHIP CONSTRUCTION. By Commander H. E. Rossell, U.S.N. 5x7½ in.; 210 pages; 70 diagrams and 6 tables. Cloth binding; price, $2.25. Published by Simmons-Boardman Publishing Co., 30 Church St., New York, N. Y.

This book is intended as a text to assist one in acquiring a sound theoretical background of design as a prerequisite to the intelligent application of design codes or regulations. The practice and theory of riveted and arc-welded joint design are given detailed consideration. In the section on arc welding, information is given that will be of aid in choosing between bare and shielded-arc electrodes for specific purposes, designing joints that will develop the required strength, taking care of expansion, contraction and warpage due to welding, making a choice between intermittent and continuous welds, and designing for water-tight or oil-tight joints. One chapter is devoted to theoretical considerations of some practical design problems, and gives analyses and formulas that will be of practical help not only to ship designers but to most fabricators using plates and structural shapes.

THE EFFECT OF DEOXIDATION ON THE RATE OF FERRITE FORMATION IN PLAIN CARBON STEELS. By C. H. Herty, Jr., M. W. Lightner, and D. L. McBride. Cooperative Bulletin 64; 6x9 in.; 40 pages; 15 illustrations and 6 tables. . . . THE EFFECT OF DEOXIDATION ON GRAIN SIZE AND GRAIN GROWTH IN PLAIN CARBON STEELS. By C. H. Herty, Jr., D. L. McBride, and S. O. Hough. Cooperative Bulletin 65; 6x9 in.; 56 pages; 20 illustrations and 12 tables. . . . THE EFFECT OF DEOXIDATION ON THE AGING OF MILD STEELS. By C. H. Herty, Jr., and B. N. Daniloff. Cooperative Bulletin 66; 6x9 in.; 52 pages; 9 illustrations and 11 tables. . . . THE EFFECT OF DEOXIDATION ON THE IMPACT STRENGTH OF CARBON STEELS AT LOW TEMPERATURES. By C. H. Herty, Jr., and D. L. McBride. Cooperative Bulletin 67; 6x9 in.; 52 pages; 24 illustrations and 6 tables. All bulletins may be obtained from John D. Beatty, Carnegie Institute of Technology, Pittsburgh, Pa., at 50 cents each.

The factor of furnace operation is a major variable in determining impact strength of normalized plain carbon steel, grain size and grain growth, and behavior of the finished product. Though a great many data on physical properties

and behavior of steel are available from past research work, the interpretation of such data generally has not taken into account the method employed to deoxidize the steel, which probably accounts for the wide variance in some of the results. The researches described in the above bulletins are intended to show just what can be expected when various means of deoxidizing are used, and also to compare "killed" or deoxidized steels with rimmed steels. Materials and methods of deoxidation are analyzed in detail, these covering the prevailing practices in steel plants.

PODRECZNIK SPAWANIA I CIECIA METALI (Manual of Welding and Drawing Metals)—Part I. By A. Sznerr and Z. Dobrowolski. 5¾x7¾ in.; 241 pages; 175 illustrations, 4 tables. Published by Stowarzyszenia dla Rozwoju Spawania i Ciecia Metali w Polsce, Mazowiecka, 7, Warsaw, Poland.

This volume deals entirely with welded fabrication. It treats of joint design and method of construction of pressure vessels, watercraft, railroad rolling stock, tank-trucks, piping, expansion joints, and other welded constructions.

TECHNIQUE OF MODERN WELDING. By P. Bardtke. Translated from the Second German Edition; 6x9 in.; 299 pages; 317 illustrations. Cloth binding; price, 15s. Published by Blackie & Son, Ltd., 17 Stanhope St., Glasgow, Scotland.

This important work contains descriptions of the various fusion welding processes, equipment used, applications of the processes, comparative economies, testing of welded joints, accident prevention, and gas cutting. The equipment and applications discussed are chiefly German. However, welding being international in extent, and problems, procedures and equipment not varying greatly as between the various countries, the author's descriptions and comments will be of interest to users of welding in other countries.

The outstanding value of this translation lies in the fact that it makes available in English for the first time many data from German research and investigations. One cannot agree with all the author's conclusions, yet the reader is given some valuable experimental evidence on important welding questions that will help him in the understanding of the physics of welding and assist him in applying the welding processes economically.

The chapter on "The Quality and Economics of Welding Processes" will be considered by many readers as the most valuable in the book. Equations for tension, shear and bending stresses are given for eight types of joints. Data on costs of riveted and welded seams, gas consumption and power consumption for various plate thicknesses, consumption of welding wire for different types of welds, welding speeds for various plate thicknesses and various types of joints, are given in the form of charts. Curves also are used to show comparative costs between forge welding and electric butt welding, as well as B.t.u. consumption required for both processes, consumption of coal, and time values.

A Welding Engineer's Wife Speaks Her Mind

■ By ONE OF 'EM

What Swell Pals These Welders Turned Out to Be!

Welding must be a great institution; nobody that's been in it ever gets out. Also, the welding crowd talks shop so much. I hear them talking welding when they drop in at our house of an evening "to get away from it." After the first five minutes the talk is all about welding. I could eavesdrop all evening and maybe hear a new cocktail recipe and a couple of new stories about Mae West, but otherwise the conversation is about as daring as you would get at the Ladies Sewing Circle, because the boys are all set to talk about welding and they can hardly wait to get the preliminaries over with.

I have found there is no use in my getting out the poker chips for a bunch of welding stiffs because they would rather chew the rag about welding than fill in the straights and flushes.

Talk about pals! If you belong to the mystic brotherhood of the torch-and-arc, all you have to do is meet up with another welding bug, and it's Old Home Week wherever you happen to be.

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We Agree on What's Wrong With Auto-Radios

Engineers do much to make life nicer, but sometimes they do pull awful boners. Take the chap who thought up auto-radios, for example. He should be put to death slowly with their bleating in his ears. Although I am a pretty fair automobile driver, myself, with years of experience, still I find modern traffic bad enough without adding the inappropriate din of music to the general mad scene.

My husband hates auto-radios even worse than I do. He has to use cabs frequently, and he used to do a lot of thinking and studying during this otherwise unprofitable time. Now that the cabs all have radios, he can't hear himself think. Even if he can induce his own driver to turn off the nuisance, all the surrounding vehicles have them turned on full force, and any avenue is a bedlam all the time.

My husband and I were in New York recently and rode in taxicabs many times. Every cab had a radio and 90% were playing "Love in Bloom." The rest were playing "Sweetie Pie." We heard those two numbers so often that we sickened with apprehension every time we took a cab and saw the driver reach for the switch. At last my husband got quite out of control. We were riding from the Grand Central Terminal to Newark, where he had to meet a client. He was trying to concentrate on a tough welding problem that had to be solved before he reached Newark—or else! So when the taxi-driver turned on "Love in Bloom," my husband kicked the works out of the set.

Regardless of the merits of the fight that followed, I had a chance to compare midwest cussing with that of New York's Lower East Side.

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He's a Mechanical Kid All Right, and Howl

Before The Boss and I were married, we stayed up late nights planning the little home we were going to have. We were waiting for the raise that would allow us to make our dreams come true. We went to movies instead of real shows, and ate in holes-in-the-wall during the engagement so that we could save our money and get that little white frame house we had our hearts set upon. Also, we were less bashful than most of the young folks at that time, and we decided we were going to have some children, and hoped there would be a girl and a boy. I remember I was terribly sentimental and wanted the boy to be mechanical like his (future) father, and we both laughed many times as we visioned our little home with our mechanical little boy playing around in it.

So much for dreams. Now about the reality. We got our little white house and our mechanical youngster, too. After years of wandering, due to the ups and downs of business, at last we have settled down in a little white frame house that happens to be almost a replica of that one we hoped for fifteen years ago. And the little boy is the kind we hoped for, too. The only fly in the ointment is that Sonny is so mechanical there's really no living with him. He's like the rascals in the funny papers who take everything apart. The clocks, the radio, the electric mixer—all have suffered from his curiosity. His electric train appears in truly fantastic places to trip the unwary. He cuts up the silk underwear of his sister and myself to make parachutes. He is only nine, but has long been a terror with a screw-driver.

When I asked the fates to send me a mechanical boy, I did not know what I was doing. I am wiser now.

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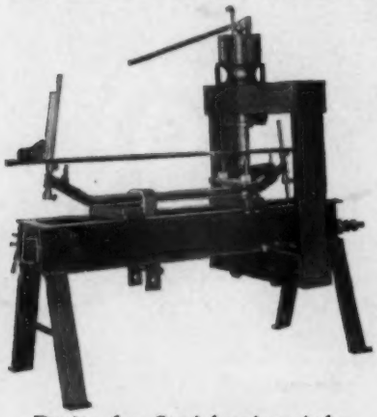
New Equipment

Axle-Wheel Straightener and Arbor Press

Many welding shops throughout the country have enlarged their business by installing hydraulic axle-wheel straighteners and arbor presses. To retain the original temper of the steel, axle and wheel straightening must be done cold. For this purpose, the Bee-Line Manufacturing Co., Davenport, Iowa, has developed a combination hydraulic axle-wheel straightener and arbor press. The



Device for Straightening Axles and Wheels.

press is fitted to its 74x12½-in. bed with machined slides to allow movement along the length of the bed. The hydraulic head may be slid crossways 28 in., and it develops 50 tons pressure.

This equipment is complete, with all necessary attachments, for straightening axles and wheels. Accurate charts are furnished, giving complete information on the front axles of all American-made cars.

Electrode Holder Avoids Accidental Grounding

The uncomfortable flashes that welders get when accidentally touching the electrode holder to grounded parts, are eliminated when using the Jackson insulated electrode holder, it is claimed. Injuries to light work, due to accidental grounding, are also avoided, so that the safety factor as an advantage is matched by the elimination of spoiled work. Avoidance of breaking the arc through striking an uninsulated holder against grounded parts while welding, is another obvious advantage.

The Jackson holder is made of a special high-strength alloy, having wear-resisting qualities and high conductivity. The cable connection can be clamped on or soldered. The handle and jaws are protected by molded, non-conducting, non-burnable insulating parts, securely attached. The manufacturer of this holder is the Jackson Electrode Holder Co., 174 Chalmers Ave., Detroit, Mich.

The Jackson Electrode Holder Is Fully Insulated Against Grounding.

They're Edgewise Tubes, Not Radiating Fins

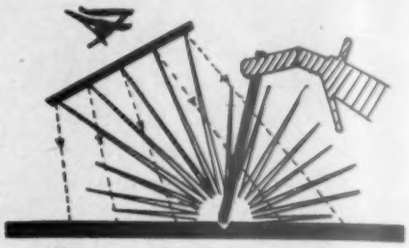
The attachments to the oil tank of the heavy-duty oil-cooled a.c. welder, designated as "radiating fins" in the description appearing on page 32 of the November issue of *The Welding Engineer*, are really edgewise tubes, states C. J. Holslag, president of the Electric Arc Cutting & Welding Co., Newark, N. J., manufacturers of the device. Oil is circulated through these tubes for cooling the transformer.

Low-Melting-Point Bronze Named "Penn Bronze"

The trade name "Penn Freeflo Bronze" has been shortened to "Penn Bronze," according to an announcement from the Titan Manufacturing Co., Bellefonte, Pa. "Penn Bronze" rods are used for bronze welding cast iron, malleable iron, wrought iron, galvanized iron, steel, brass and bronze, and melt at 1620° F. A three-months' series of periodic tests with these rods used in the welding of steel showed yield points between 35,370 and 35,580 lb. per sq. in., ultimate tensile strengths of 55,680 to 57,000 lb. per sq. in., and an elongation in 2 in. of 14.06% to 18.75%. Rigid specifications and raw materials of very high purity insure high uniformity, the manufacturer states.

New Arc-Welding Lens Allows Clearer Vision

An increase of 75% in visibility, with no sacrifice of eye protection, is afforded by the new Agile welding lens, according to claims made by the American Agile Corp. These lens consist of a dark glass

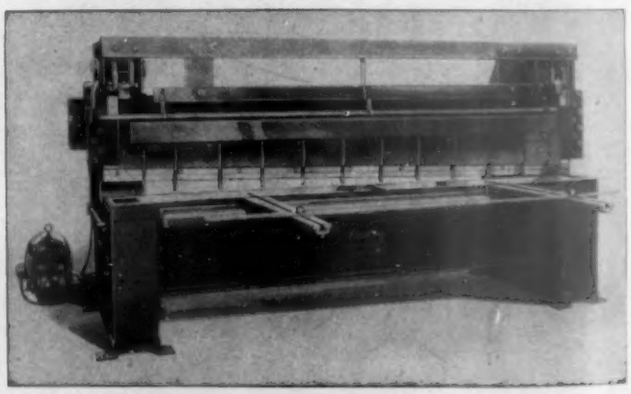


Injurious Rays Do Not Penetrate Past the Mirror.

and a mirror, the latter being placed to reflect the injurious rays of the arc away from the welder's eyes, and prevent them from penetrating past the mirror. Thus the dark lens can be made of less density than in the conventional lens, it is claimed. Further details can be had from the American Agile Corp., 5806 Hough Ave., Cleveland, Ohio.

Deflection Eliminated in Welded Shear

Through the use of rolled-steel welded construction, together with steel castings and the elimination of delicate working parts, a shear has been produced by the Beatty Machine & Manufacturing Co., of Hammond, Ind., that is unusually rigid and substantial in construction. Safety is assured by the enclosing of all working parts and the use of push-button control instead of a foot lever. No flywheel is employed, and there is no moving counterweight or noisy clutch.



This Shear Employs No Flywheel or Moving Counterweight.

TOBIN BRONZE...

used to fabricate 13,000-lb. hammer

935 *lbs. of rod deposited in 14 hours*

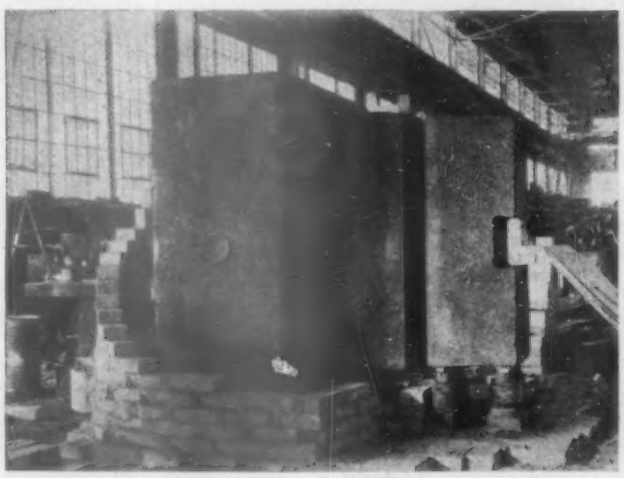
HOW best to join the cast iron bottom and steel top of a 13,000-lb. steam anvil hammer? That was the question faced by a mid-western railroad shop... and solved by Tobin Bronze welding!

Because of the unusual nature of the job, a pre-heating furnace was built around the massive base . . . (in ordinary work the low melting point of Tobin Bronze usually makes pre-heating unnecessary). The weld was made vertically, to prevent the molten bronze from working ahead to insufficiently heated areas. Using two oxy-acetylene torches, it required but 14 hours to deposit 935 pounds of Tobin Bronze Rod and complete the weld.

Tobin Bronze was the choice for this particular job because of its uniformly high quality ... its "day in and day out" dependability. For the same reasons, thousands of experienced welders will use no other brand for the general oxy-acetylene welding of cast and malleable iron.

Anaconda Publication B-13, new edition, contains a wealth of practical bronze-welding information and describes the complete line of Anaconda Rods. Copies gladly mailed on request.

Ready for welding. Note the weld area between the steel top and the cast iron bottom.



The finished job . . . 13,000-lb. hammer fabricated with Tobin Bronze.

ANACONDA
from mine to consumer

THE AMERICAN BRASS COMPANY
General Offices: Waterbury, Connecticut
Offices and Agencies in Principal Cities
In Canada: ANACONDA AMERICAN BRASS LTD., New Toronto, Ontario

NRA CODE

ANACONDA WELDING RODS

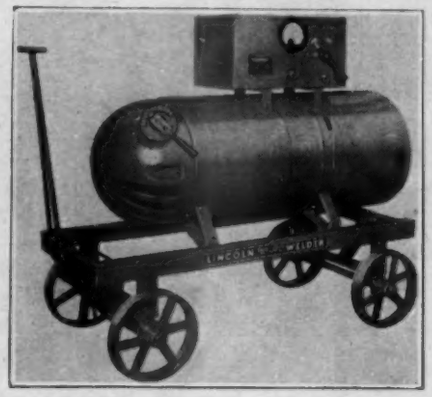
The gap or throat cannot expand during splitting operations, it is claimed, and vertical deflection is impossible inasmuch as all vertical strains are transmitted to the ram and cannot be borne by the throat. Large or small sheets may be sheared within full view of the operator at all times, and an adjustable rear squaring gauge is provided, with a range of 2 in. from the blade to any specified width. This shear is available in several sizes.

New A.C. Welder Featured by Low Power Bills

An alternating-current welder of the motor-generator type, which allows a.c. welding without the unbalancing of the power-line phases, has been developed by The Lincoln Electric Co., Cleveland, Ohio, and is known as the "Shield Arc AC." The unit is designed for operation from 2-phase and 3-phase circuits, and it converts the current into a higher frequency that is suitable for welding with either heavily coated or washed electrodes in all positions, it is claimed.

The higher frequency is said to result in a more stable arc, less magnetic blow, and an easier starting of the arc. The spatter loss is said to be minimized, and a dense weld is obtained, especially in multiple-pass welding. The power factor is as high as would be expected with any motor-generator type of d.c. welder, since no transformer is used, and it is said that the current drawn from the line is no more than that drawn by the corresponding d.c. welder.

The "Shield Arc AC" is made in two sizes: The smaller can be used for continuous welding with electrodes of 3/32 to 5/16 in., and the larger size for continuous welding with electrodes of 1/8 to 3/8 in.



New Lincoln A. C. Welder of Motor-Generator Type.

Trade Literature

G-E welding electrodes are described as to operation, application and type, and their distinguishing features shown in Bulletin GEA-1546B, a new catalog issued by the General Electric Co., Schenectady, N. Y. Included are bare and lightly fluxed electrodes for hand and for automatic welding, and heavily coated electrodes for hand welding alone or for both hand and automatic. A condensed chart gives the major applications of these electrodes, and characteristics of electrodes and welds are also given in chart form. Tables also give chemical contents as well as current and arc voltage values. Various accessories and welding equipment are also illustrated.

"Pipe Thawing With Hobart 'Simplified' Arc Welders" is the subject of a booklet in mimeographed loose-leaf form, issued by Hobart Bros., Box U-124, Troy, Ohio. Fourteen actual cases are discussed, and a sketch given for each to show the application of welding current for thawing pipes. In each case, the complete circuit is described, total length given, and data given on the length and size of cables, meter readings, time required to thaw out, cost of power and labor, charge made to customer, type of machine used, and other details. Though priced at 40 cents, this interesting booklet is available free to readers of *The Welding Engineer*.

General Electric arc welders, Type WD, are described and illustrated in Bulletin GEA-1440C, issued by the General Electric Co., Schenectady, N. Y. Dimensions, ratings and weights are given. Oscillograms are reproduced to show voltages and currents before and after a brief period of dead short-circuit, thus illustrating the quick voltage recovery and limited current peak attributed to these generators. Factors of design and operation are discussed.

"Precautions and safe practices in the storage, care and handling of oxyacetylene welding and cutting equipment" is the title of a 24-page booklet, published by The Linde Air Products Co., 30 East 42nd St., New York, N. Y., which supersedes the former booklet of that title. The 129 rules given cover the handling and care of cylinders and hose, setting up the apparatus, and recommendations for operating and maintenance.

Eye and face protection devices and welding accessories manufactured by the Fibre-Metal Products Co., Chester, Pa., are described in a new profusely illustrated 32-page catalog issued by that company. Among the items listed are Eureka electrode holders, the Vulcan carbon-electrode holder, welding helmets and handshields, and folding leather pocket shields.

The designing of expansion loops, using Tube-Turns and straight lengths of pipe or tubing, is made easy by reference to a chart contained in a pamphlet recently issued by Tube-Turns, Inc., Herald-Post Bldg., Louisville, Ky. A number of very interesting installations are shown. A table gives the thermal expansion of pipes at various temperatures.

"Recommended Practices for Gas Cutting of Structural Steel" is the subject of a 16-page booklet, issued by The Linde Air Products Co., 30 East 42nd St., New York, N. Y. This is divided into five sections: Definitions; general recommendations; qualification tests for workmanship; safety precautions; and recommendations on cutting practices.

Manganese-steel welding, in the repairing of manganese-steel castings and building up chilled-iron crushers, is described and various types of work illustrated in a folder issued by the McLean Welded Products Corp., 530 West 79th St., Chicago, Ill., who specialize in manganese-steel welding and in hard-facing.

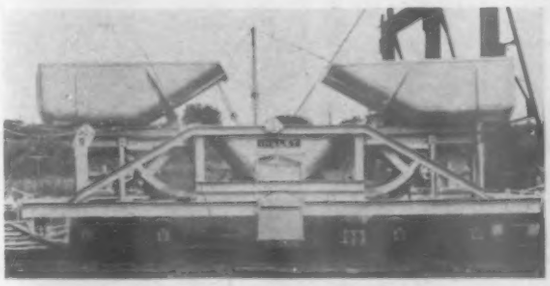
"Shield-Arc Welding Builds Better Ships" is the title of a folder containing illustrations of watercraft built with arc welding. The aircraft carrier *Ranger* is shown, in which 333,000 lb. of "Fleetweld" was used. Copies of the leaflet can be obtained from The Lincoln Electric Co., Cleveland, Ohio.

The Briggs portable, fully automatic spot welder is described in a booklet issued by The Briggs Manufacturing Co., Detroit, Mich. Detailed information is given on the trigger control and the water-cooled transformer. Several types and forms of guns are illustrated.

Airco's shielded-arc electrodes are described in a folder issued by the Air Reduction Sales Co., 60 East 42nd St., New York, N. Y. Electrodes are listed for flat welding and for vertical and overhead work. A table of recommended current values also is given.

Electrodes for stainless-steel welding are listed in a pamphlet issued by Arcos, Inc., 401 N. Broad St., Philadelphia, Pa.

ADAMS ELECTRODES WELD HUGE NORRIS DAM EQUIPMENT



The concrete handling equipment illustrated above was made by the Insley Manufacturing Co. of Indianapolis, Ind., for the Tennessee Valley Authority. These special cars and buckets (each bucket weighing 7,000 lbs. and carrying 24,000 lbs. of concrete) are all-electric-welded with Adams "Tankcraft" Electrodes. The 68,000 to 72,000 lbs. per square inch ultimate tensile strength of "Tankcraft" fusion metal with ductility of over 25% gives assurance that this equipment will withstand the heavy shock stresses to which it will be subjected.

Let us tell you more about these new "Tankcraft" Electrodes, which may be used for horizontal, vertical or overhead welding.

The Adams line includes Arc-Welders, Automatic Welding Heads, Automatic Welding Wire, Shielded, Processed and Bare Electrodes and Welding Accessories.

J. D. ADAMS COMPANY

Arc-Welding Equipment and Electrodes

INDIANAPOLIS, INDIANA

The New Willson

CHIP-WELD GOGGLE

A serviceable welding type one moment and an efficient chipping type the next . . .

One welding lens is raised here to show how the roomy cups of style DC50 permit ready use over regular spectacles.

Professional Welders showed us how to make the Chip-Weld, many models of which were made and tested before the goggle illustrated was perfected. The molded black composition cups of Style DC50 are shaped to fit the curves of the face. Two indirect ventilating ports in each cup provide a sufficient flow of air.

50 mm. clear Super-Tough lenses furnish strength against impact of flying particles. In the same goggle, in hinged frames which may be raised readily, are 50 mm. Willson-Weld lenses for protection against dangerous light rays. This glass of special chemical character filters out injurious rays from intense light as present in welding, burning, cutting, brazing, furnace observation, smelting and similar work.

One welder friend tells us he trimmed several hours off an estimated twenty-hour job by not having to remove his goggles for observation. If you are interested in this or any of the other exclusive Chip-Weld features, clip and check this ad, sign and mail to us for:

☐ Printed Folder ☐ Quantity Price
☐ Interview ☐ Sample C.O.D.

Price: Style DC50 $4.50 each, f. o. b. shipping point.

WILLSON PRODUCTS, INC.

Reading, Pa.

Instructions are given for welding various stainless steels, and chemical analyses and weights of Chromend stainless electrodes are given.

"Arc Welding Supplies" is the subject of a new catalog issued by R. D. Thomas & Co., 401 N. Broad St., Philadelphia, Pa., which describes 24 grades of welding electrodes and illustrates electrode holders, shields, helmets, and other accessories.

A comparison of arc-welded and riveted designs for fixed-end connections of beams to columns, is given in "Studies of Structural Arc Welding," Plate 47, recently issued by The Lincoln Electric Co., Cleveland, Ohio.

Sil-Fos, for low-temperature brazing of non-ferrous metals and alloys, is described and uses listed in an illustrated folder issued by Steel Sales, 129 S. Jefferson St., Chicago, Ill.

Commercial News

Eckman Heads Research at Thomson-Gibb Company

M. L. Eckman, formerly engineer for The Federal Machine & Welder Co., and for many years prominently identified with the welding industry, has been chosen to head the research and development department of the Thomson-Gibb Electric Welding Co., with headquarters at Lynn, Mass.

Mr. Eckman's broad experience with production welding problems includes intimate, practical knowledge gained from the standpoint of users of production welding equipment as well as designers and builders of such equipment. He was at one time associated with the Ford Motor Co., and he has spent considerable time in Europe with users as well as manufacturers of welding equipment. He is regarded as an authority on advanced welding practices in all the leading industrial countries, including the United States.

Emery Transferred to Detroit

W. V. Emery, who for the past ten years has been with the Harnischfeger Corp., of Milwaukee, has been transferred to the corporation's Detroit office, in charge of P&H-Hansen arc welder sales for that area. During his association with Harnischfeger, Mr. Emery was in charge of all welding operations and also served in a consulting and promotional capacity. Previously, he was for five and one-half years with the Seeman Body Co., of Milwaukee.

The Wisconsin Oxygen & Hydrogen Co., Kenosha, Wis., has been merged with Compressed Industrial Gases, Inc., 221 N. La Salle St., Chicago. The plant at 6313 Thirty-first Ave., Kenosha, will continue in operation as heretofore. A. H. Steinbrecher, of the Kenosha company, becomes vice-president in charge of operations of Compressed Industrial Gases, the other officers of which are: H. B. Pearson, president; E. A. Faulhaber, executive vice-president; C. T. Price, vice-president in charge of sales; W. J. Moran, treasurer; and E. Hepler, secretary. Compressed Industrial Gases also recently acquired the Mo-Ark Oxygen Co., of Fort Smith, Ark. L. H. Good continues as manager of the Fort Smith plant.

The report regarding the new connection of R. C. Anderson in the Boston territory, which appeared in the November issue of *The Welding Engineer*, should have given the distributor's name as Welding Engineering Sales Corp., 140 Federal St. They are maintaining a complete stock of welding equipment and accessories, Mr. Anderson reports.

The John Huntington Polytechnic Institute welding course for engineers, foremen and welding supervisors, was transplanted to Pittsburgh, Pa., and held in the Chamber of Commerce auditorium during the week of December 3rd. Approximately 250 were enrolled.

Thomas T. Watson, who joined the metallurgical department of the Lukens Steel Co., Coatesville, Pa., in 1931, has been appointed development and service metallurgist. He will be engaged chiefly in service and sales work in connection with Lukens nickel-clad steel.

Oster-Williams, of Cleveland, Ohio, have opened an office and display room at 292 Lafayette St., New York, N. Y., in charge of H. B. Van Osten, district manager. Machines are on display for actual demonstrations of pipe and bolt threading.

The Champion Rivet Co., Cleveland, Ohio, announce the following new distributors for their welding electrodes: Root Neal & Co., Buffalo, N. Y., for western New York State, and Tanner & Co., Indianapolis, Ind., for the state of Indiana.

New distributors of Enduro stainless steel are: Buhl Sons Co., Detroit, Mich.; F. W. Heitmann Co., Houston, Texas; and The Woodward Co., Albany, N. Y., according to an announcement from N. J. Clark, of the Republic Steel Corp.

The John Tillman Co., of Long Beach, Calif., manufacturers of welders' protective leather goods, formerly located at 2684 American Ave., has moved into larger and more convenient quarters at 2716 American Ave.

Harvey Winkleman, formerly in charge of sales and service in the Cleveland territory for the M. Keith Dunham group of companies, has been transferred to the Chicago territory.

K. L. Hansen, of the Harnischfeger Corp., Milwaukee, Wis., will address the Cleveland Section of the American Welding Society at their meeting to be held on Jan. 9th.

J. B. Flock, formerly representative for The Lincoln Electric Co. in the Pittsburgh district, has been transferred to the Tri-City district, with headquarters at Moline, Ill.

The Ryerson Company is completing an extension to their Milwaukee, Wis., plant at 244 South 19th St., which will almost double its former warehousing capacity.

Charles Pack has rejoined the Doehler Die Casting Co., New York, N. Y., in the position of assistant to the president in charge of all research and development work.

H. E. Menefee, formerly with the W. J. Holliday Co., Indianapolis, Ind., is now connected with Tanner and Co., steel merchants, of the same city.

Frank Maichle, salesman for The Lincoln Electric Co., has been appointed manager of the Pittsburgh district for the same company.

Toncan Iron sheets, made by the Republic Steel Corp., are now being distributed by Steel Products Co., McKees Rocks, Pa.

Leonard Ross has been appointed Cleveland district representative for The Bastian-Blessing Co., Chicago, Ill.

Arcos has moved their Paris (France) office to 52, Rue du Reservoir & 3, Rue du Port, Clichy (Seine).

Notes From the Field

The Howell & Parker Machine & Welding Works, of Ada, Okla., formerly the Vickers Machine Works, of Oklahoma City, are operating as a repair welding and machine shop. They are engaged in building up and hard-surfacing drill bits.

Welded steel pipe will be used in the construction of the Freda siphon, a section of the Colorado River Aqueduct in Southern California now under construction. The contract for this pipe was awarded to the Consolidated Steel Corp.

Much welding will be employed in the early construction of a brew house for the Grace Bros. Brewing Co., of Santa Rosa, Calif. This work will include the construction of 18 large all-welded steel tanks, together with welded structural steel supports, piping, etc.

Indicative of the growth of the Institution of Welding Engineers (British), is the appointment of F. Stoyle as full-time secretary and the acquisition of new offices at 7/8 Holborn Hall, Grays Inn Road, London.

The Acme Pipe Co., of San Diego, is completing an interesting piece of welding, being an all-welded paper press. The press is being made of old street-car rails, and will have a pressure working capacity of about 40 tons. A big saving in weight and fabricating cost is effected through the welded type of construction.

Elmer Mayfield recently opened a boiler and welding shop in the new Ada, Okla., oil fields. He is a veteran in the oilfield-welding business and has followed oil booms for many years.

The plant of the West Side Welding Co., 807 Commercial St., Waterloo, Iowa, is being remodeled and the interior rearranged to make the plant and building modern.

A welding school has been opened at 5202 Van Dom St., Long Island City, N. Y., by F. J. Giroux, it is reported.

· CLASSIFIED ADS ·

Help Wanted—75c per line, minimum 4 lines. Jobs Wanted—4 lines free. Other Ads—$1.00 per line, minimum 4 lines. Count 8 words to line. Add 6 words for keyed address.

WANTED TO BUY

Arc Welder Wanted—200 or 300 amp. State condition, age, price, make and R.P.M. Address D-4, The Welding Engineer.

FOR SALE

Bargains—5-operator G-E 800-amp. welder, a.c. motor drive, A1 condition. Also Lincolns, Wilsons, and others in stock, for sale or rent. Guaranteed. Service Co., 3741 Cedar Ave., Cleveland, Ohio.

Bargains—Demonstrator Arc Welders. Gasoline, electric drive, belted, or coupled-together outfits. 30 days' trial. Easy terms, if desired. Write Ken's Welding Exchange, Box U-1141, Troy, Ohio.

BUSINESS OPPORTUNITIES

Fine Opportunity for welding engineer and alert sales promoter to settle for future. Some capital required. Welding and radiator company in heart of New Jersey, established over 20 years, needs new blood as executive. Kappertz, Morristown, N. J.

High-Class Representative Wanted—To get jobbers for Wilco Electric Welding Machines. Business established 12 years. Liberal commission. Write for territory. Wilco Electric Welders, 446 State Ave., Kansas City, Kansas.

POSITIONS WANTED

Supervisor and Inspector—Connected for several years with firm engaged in railroad welding, including railends and manganese crossings. Also experienced as shop inspector and superintendent of plant with manufacturer of railroad-track material, and served for several years in engineering department of large Western railroad. Graduate of Lincoln Electric Co.'s supervisors' course. Address D-5, The Welding Engineer.

Mechanic and Welder—With large coal company for past 3 years; prior to that, worked as mechanic and foreman in shop for 11 years. Experience with gas welding dates back to 1920, and arc welding back to 1929. Experienced with various makes of welders and rods. High school graduate; 29 years old; married. Address D-2, The Welding Engineer.

Shop Superintendent—Can take complete charge of shop making stainless-steel dairy equipment. Experienced in designing, estimating, layout, welding, fabricating and finishing. Reputation and integrity well established. Can manage men and get results. Accomplishments well known to the trade. Address D-3, The Welding Engineer.

Sales Engineer—Eight years' experience in sales of welding equipment, including arc welders and supplies. Six years' experience welding, both gas and arc; served two years as welding engineer for oxygen company. 34 years old; married. Address D-1, The Welding Engineer.

MAKE STRONGER WELDS FASTER IN

No Puddling **WHITE METAL** No Flux

White Metal is easily and quickly welded with Aladdin Rod at a profit. Don't continue to lose profit by turning down White Metal parts. Only Aladdin Rod is guaranteed to produce welds of greater tensile strength than original metal. Unexcelled as an aluminum solder. Directions with each pound. If your jobber cannot supply you, order direct.

Assorted, 1/16 and 1/8 in., $2.50 per lb. 1/8 in. rod, $2.75 per lb.

THE ALADDIN ROD & FLUX MFG. CO., 947 Fifth Ave., Des Moines, Iowa

LEARN WELDING

At a liberally endowed and well established trade school. Founded in 1907. Practical shop instruction. Tuition fee $10.00 per week. Free catalog sent on request. Enroll now.

THE DAVID RANKEN, JR.,
SCHOOL OF MECHANICAL TRADES
Finney, Newstead, and Cook Aves.
St. Louis, Mo.

TITAN

doubly deoxidized

Bronze Welding Rods

Trade Mark Registered

The definitely superior welds secured by use of TITAN BRONZE WELDING ALLOYS are due to use of the purest obtainable raw materials, strict laboratory control and *double deoxidation.*

The double deoxidation process developed by Titan metallurgists eliminates injurious gases and produces alloys with excellent bonding properties, resulting in welds that are dense, non-porous and of great strength and high ductility.

The use of the purest ingredients such as electrolytic copper 99.96 in purity and electrolytic zinc 99.99 plus, in Titan Bronze Welding Alloys, is a further assurance of superior welding results.

Exceptional low-melting is an outstanding feature of Titan Bronze Welding Alloys. A trial will easily prove this.

Uniformity of mixtures and casting temperature are essential to good welding results. The strict laboratory control exercised in the manufacture of Titan Welding Rods assures the user of *absolute uniformity.*

Specify Titan Bronze Welding Rods for the welding of cast iron, malleable iron, wrought iron, galvanized iron, steel, brass and bronze, and thereby assure yourself of the finest obtainable welding results.

Samples of our Penn Bronze, Titan Bronze, Titan Brazing Bronze and Titan Manganese Bronze Alloys, gladly forwarded upon request. Write for descriptive circular.

TITAN METAL MFG. CO.
Bellefonte, Penna.

AT LAST

Alternating Current Arc Welding Has Come Into Its Own

It is recognized by the highest authorities, for its major advantages, absence of magnetic blow in the arc (resulting in superior welds), easier to make fillet welds, easier to weld in corners, gives deeper penetration, greater welding speed.

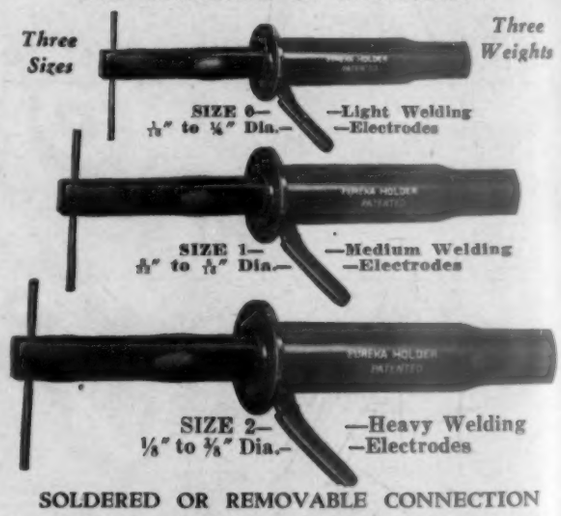
OWEN Induction Arc Welders are not ordinary A. C. welders. They will do your work more efficiently and more economically than any other arc welder built.

In addition to our present line, we will soon announce our New Line of OWEN Gasoline-engine driven, A. C. Power Plants. Also OWEN Unity Power Factor Transformer Welders; the greatest achievement in the history of welding.

OWEN ELECTRIC MFG. CO.
FAYETTEVILLE, NORTH CAROLINA

EUREKA
ELECTRODE HOLDERS

THE STANDARD OF PERFECTION


Three Sizes
Three Weights
SIZE 0— 1/32" to 1/4" Dia.— —Light Welding —Electrodes
SIZE 1— 1/8" to 1/8" Dia.— —Medium Welding —Electrodes
SIZE 2— 1/8" to 3/8" Dia.— —Heavy Welding —Electrodes

SOLDERED OR REMOVABLE CONNECTION

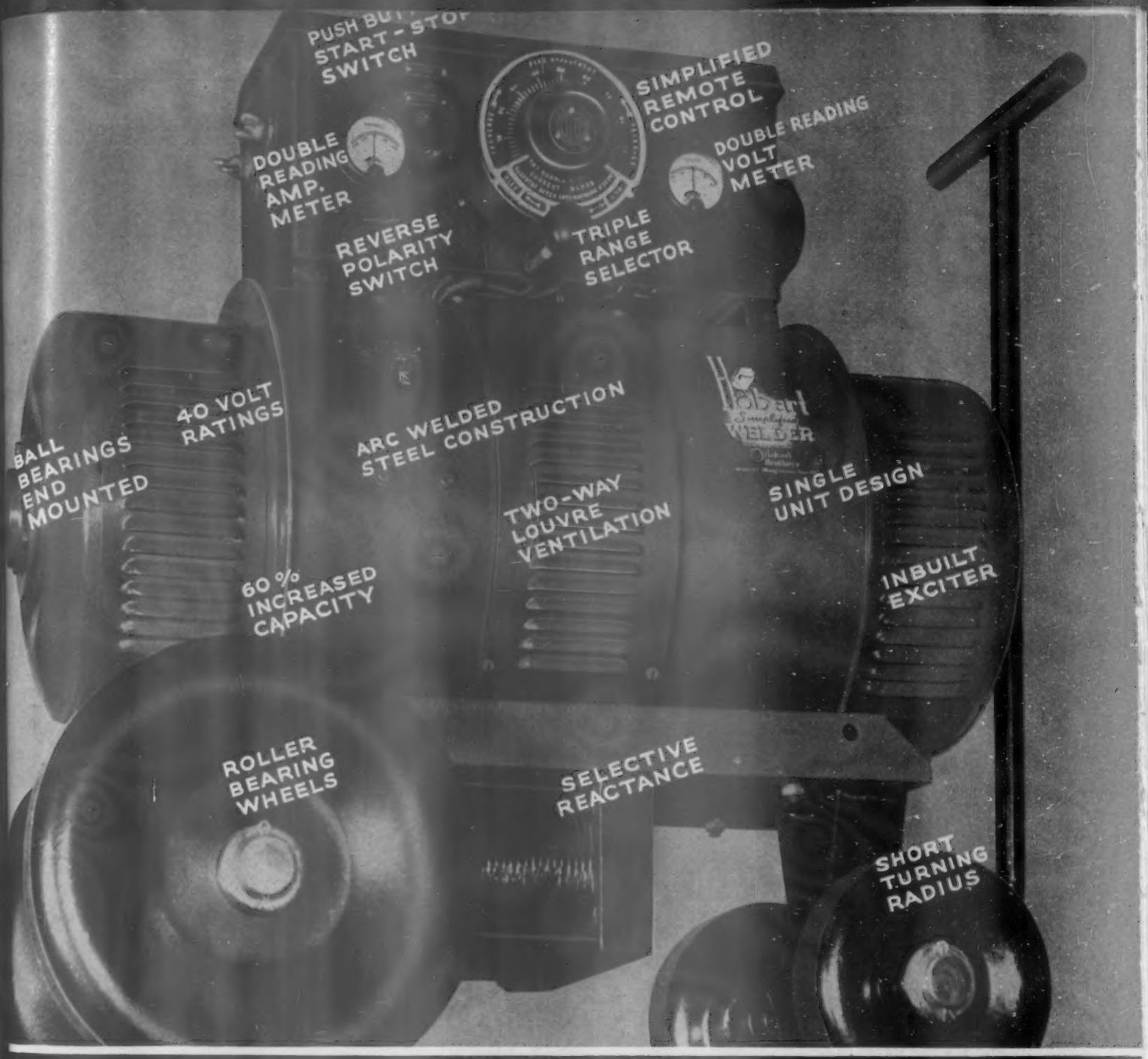
NO SCREWED JOINTS TO HEAT

Worn Jaws Easily Replaced at Low Cost. No Springs.

GUARANTEED TO OUTLAST ANY TWO OTHER HOLDERS NOW ON THE MARKET.

Sold Thru Mfgrs. of Arc Welding Equipment and Jobbers of Same.

THE FIBRE-METAL PRODUCTS CO.
CHESTER, PA.



E NEW HOBART 40 VOLT "SIMPLIFIED" ARC WELDER

NVESTIGATE! COMPARE! *Get 30 days trial*

Discover the new welding speeds and performance that come with this new Simplified welding. No extravagant claims or salesmen's promises have made this the fastest selling Welder on the market today—just new records of performance with lower welding costs and easier handling than you ever thought possible—that's why we originated the 30 DAYS' TRIAL to let you KNOW, COMPARE, and actually use this "5 Year Ahead" Welder.

GET YOUR MONEY'S WORTH

Know that your Welder handles plain rods as well as coated rods economically and easily. Automatic reactance that goes to work for easier welding on low range work and cuts out for economy on higher range is found only in Hobart. Remote Control—THAT REALLY WORKS—without extra cost—comes only with Hobart. OVERSIZE Capacity—no skimp motor or generator ratings to meet price requirements. Get a Hobart on 30 DAYS' TRIAL and you'll understand why it gives you the lowest cost welding on the market.

HOBART

Send COUPON *for details*

Hobart Bros., Box U124, Troy, Ohio

Send me data on your new 40 Volt Simplified Welding together with your liberal 30 Day Trial offer. I am interested in—

- ☐ Electric Drive
- ☐ Gas Engine Drive
- ☐ Build Your Own
- ☐ 125 Amp.
- ☐ 200 Amp.
- ☐ 300 Amp.
- ☐ 400 Amp.
- ☐ 30 Days' Trial
- ☐ Easy Terms.

Name.....

Address.....

☐ **Send me the new CARBON ARC MANUAL.**

e of the Largest Builders of Arc Welders in the World

They'll TELL YOU

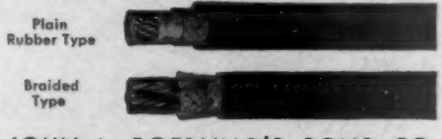
IT'S THE CUSTOM-MADE STEEL THAT SPELLS THE DIFFERENCE!

WELDERS who use Roebling Welding Wire will tell you that it is outstanding for uniformity and freedom from non-metallic impurities. It should be. The steel for this wire is custom-made specifically for welding.

To begin with, only special, pure melting stock is used to make Roebling Welding Steel. Then, small open-hearth furnaces, permitting very close control of the melt, are employed in the exacting refining process. This is far different than making steel on the usual tonnage basis. And, there is a difference in the result.

You will find it worthwhile to send for samples and data on Roebling Custom-Made Welding Wire. It is made in both gas and electric types.

ROEBLING WELDING CABLES: These cables are made in a complete line for arc welding purposes. Many leading welders consider them to be the finest welding cables on the market. Samples, data and prices gladly furnished.

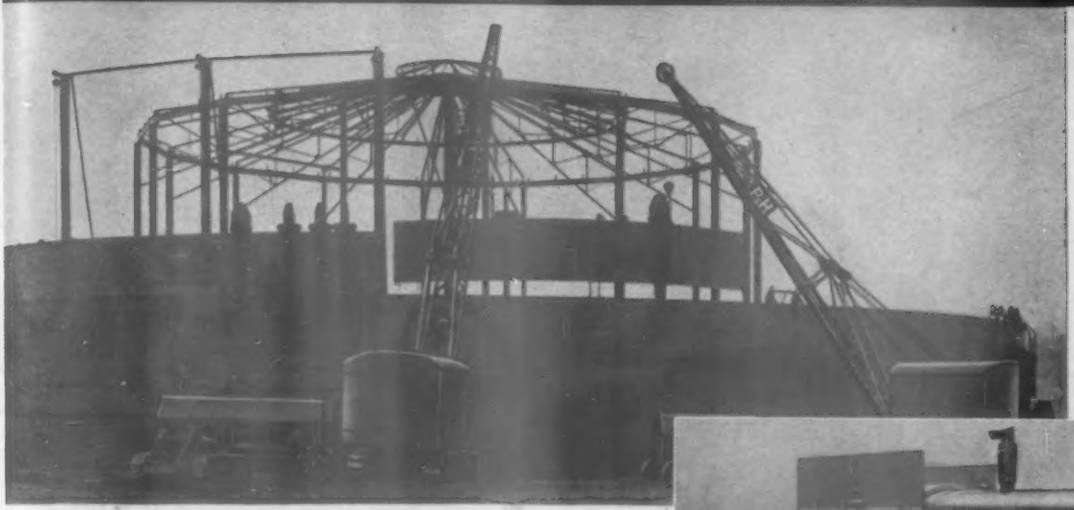


JOHN A. ROEBLING'S SONS CO.
Trenton, N.J. *Branches in principal cities.*

ROEBLING WELDING WIRE

Custom Made

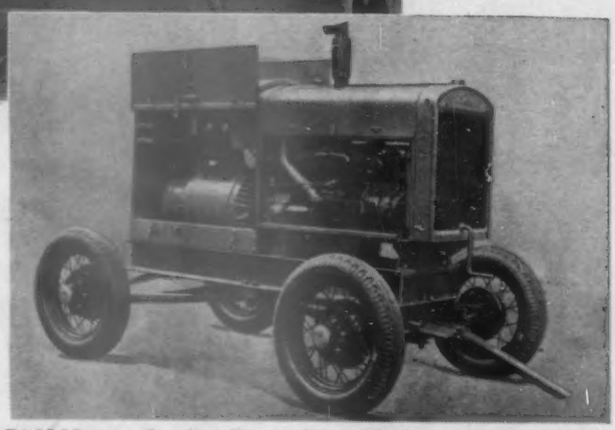
World's Largest Arc Welded Tank built with ten P&H-HANSEN WELDERS



This 6,000,000 gallon tank is entirely self-supporting — welded throughout. The lowest row of plates are 1-3/16 in. thick, welded to a steel plate floor. Each succeeding row is slightly thinner to allow for a good strong bead on both inside and outside. Walls are 37 feet high. P&H-Crawler Cranes set the steel.

No sir—not a rivet in this 6,000,000 gallon water tank built for the city of Milwaukee. It was a pioneering job, and one in which the contractors could take no chances with the welding apparatus.

Welders *had* to be good — quality of welds had to be high — metal had to be laid fast — and the job had to be done at a price. P&H-Hansen Arc Welders — ten of 'em — were selected for this important work. P&H-Hansens are built by an organization that has had fifty years experience in the manufacture of electrical equipment and contractors' equipment.



P&H-Hansen Gasoline Powered Arc Welders are economical in operation—fast, sturdy, dependable. You'll lay more metal with a P&H-Hansen, you'll lay it more uniformly—and for less money. There's a size and type for every need.

P&H-Hansens are rugged, simple to operate, dependable performers under all conditions. You'll find 'em on tough jobs in factory and field alike. Write today for complete data on the new line of P&H-Hansen welders for construction work.

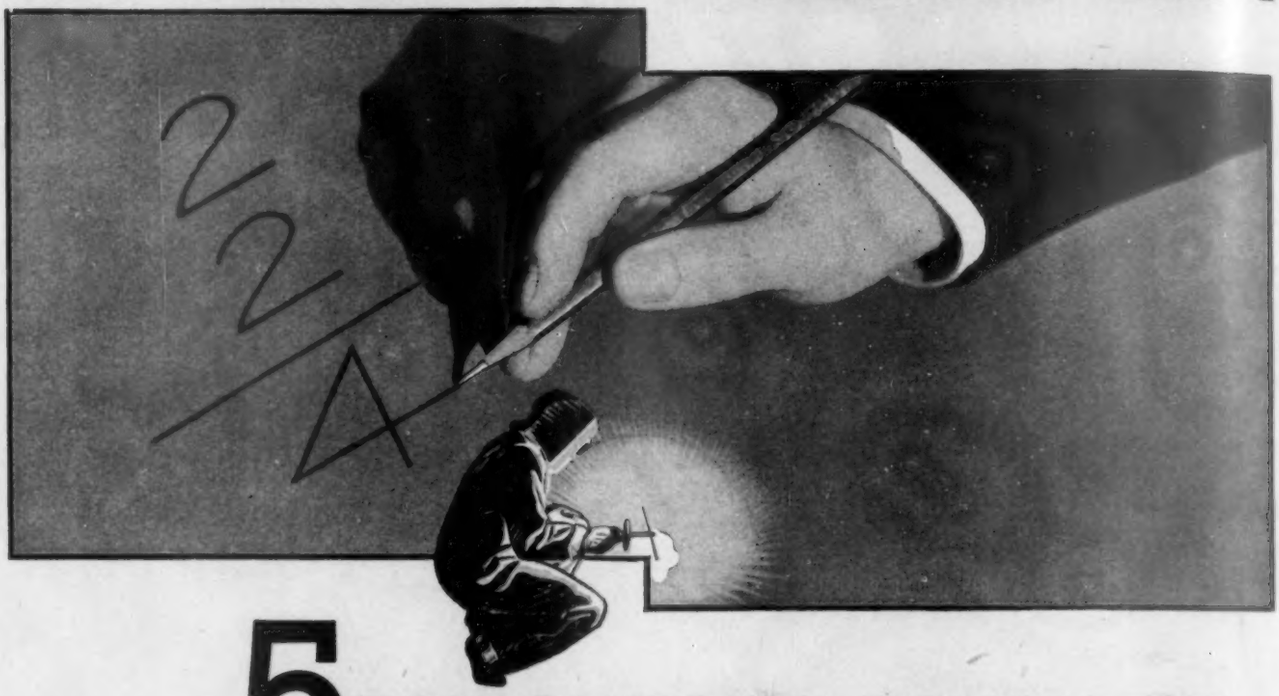
HARNISCHFEGER CORPORATION
4513 W NATIONAL AVE *Established 1884* MILWAUKEE, WIS.

P&H-HANSEN ARC WELDERS

NRA CODE

BACKED BY 50 YEARS OF EXPERIENCE

It Pays to be CERTAIN



5 IMPORTANT FACTORS ELIMINATE GUESS WORK . . .

FORTUNATELY—there is no need to gamble quality of Welding Wire against a perfect finished job. Thousands of welders know this—know how Premier Tested Welding Wire offers a five point program in service and manufacture that makes guess work unnecessary—eliminating disastrous and costly errors. First: the control of raw material from mine to manufacture, eliminates all doubt as to basic quality. Second: sales and technical cooperation assure a grade and type of wire exactly suited to your needs. Third: laboratory control maintains constant uniformity. Fourth: frequent shop tests establish an added safeguard. Fifth: the grade is plainly stamped on every wire and rod—you simply can't go wrong.

It will pay you to request complete details from us—as well as test samples covering your specific needs. In addition—a copy of our latest Welder's Handbook will be forwarded to you.

1831 MORE THAN 100 YEARS of PROGRESS in WIRE MAKING **1934**

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SUBSIDIARY OF UNITED STATES STEEL CORPORATION
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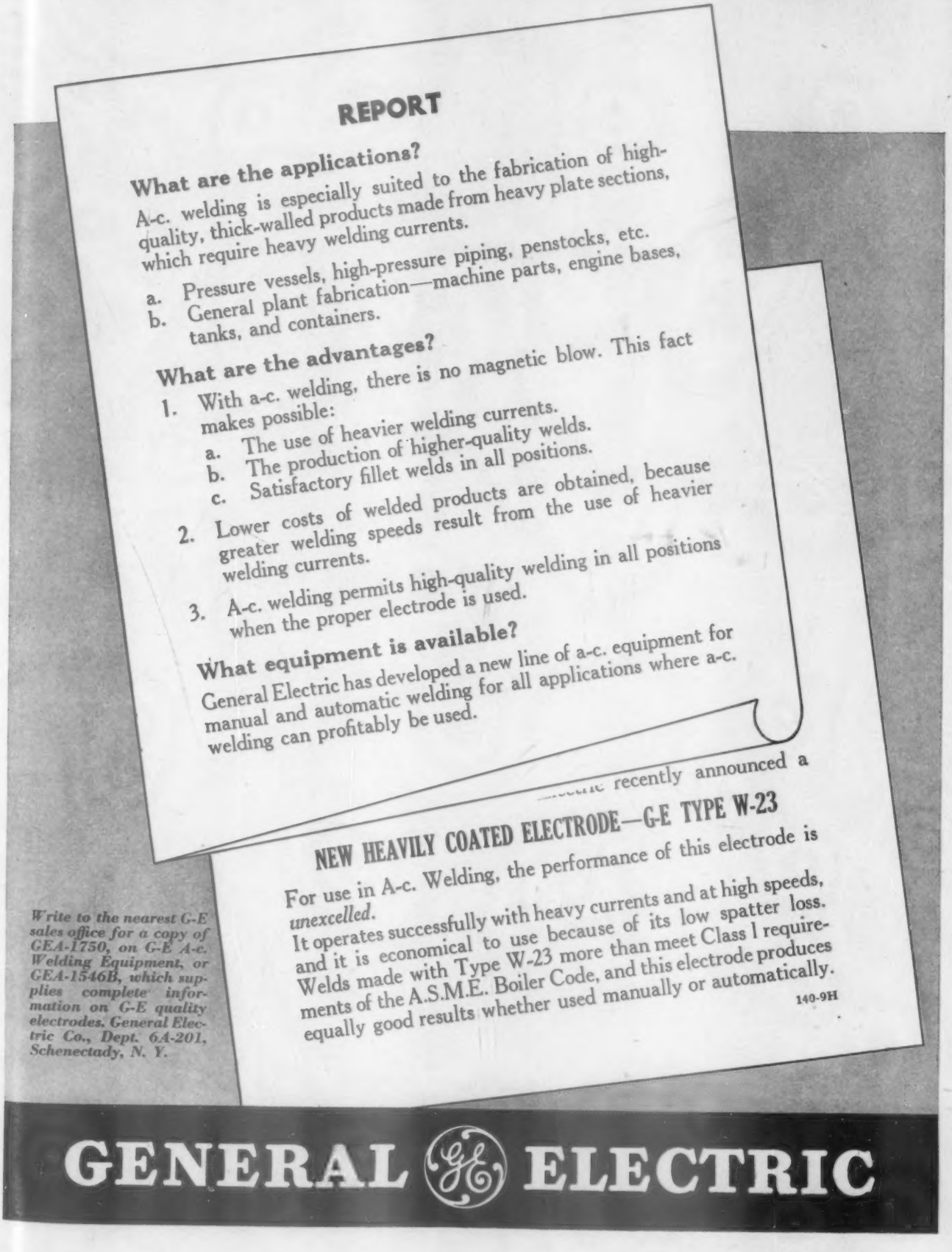
A report on the findings of 15 years' investigation of Alternating-current Welding



REPORT

What are the applications?

A-c. welding is especially suited to the fabrication of high-quality, thick-walled products made from heavy plate sections, which require heavy welding currents.

a. Pressure vessels, high-pressure piping, penstocks, etc.
b. General plant fabrication—machine parts, engine bases, tanks, and containers.

What are the advantages?

1. With a-c. welding, there is no magnetic blow. This fact makes possible:
   a. The use of heavier welding currents.
   b. The production of higher-quality welds.
   c. Satisfactory fillet welds in all positions.
2. Lower costs of welded products are obtained, because greater welding speeds result from the use of heavier welding currents.
3. A-c. welding permits high-quality welding in all positions when the proper electrode is used.

What equipment is available?

General Electric has developed a new line of a-c. equipment for manual and automatic welding for all applications where a-c. welding can profitably be used.

...ectric recently announced a

NEW HEAVILY COATED ELECTRODE—G-E TYPE W-23

For use in A-c. Welding, the performance of this electrode is *unexcelled.*

It operates successfully with heavy currents and at high speeds, and it is economical to use because of its low spatter loss. Welds made with Type W-23 more than meet Class I requirements of the A.S.M.E. Boiler Code, and this electrode produces equally good results whether used manually or automatically.

140-9H

Write to the nearest G-E sales office for a copy of GEA-1750, on G-E A-c. Welding Equipment, or GEA-1546B, which supplies complete information on G-E quality electrodes. General Electric Co., Dept. 6A-201, Schenectady, N. Y.

GENERAL ELECTRIC

Business Men's PROSPERITY SURVEY

HERE'S a chance to give voice to your own ideas as to which national policies you believe most likely to speed recovery in your line of business.

BALLOTS like this are being published this month in many business papers affiliated with The Associated Business Papers, Inc.—reaching virtually all key men in every line of industry, trade and profession throughout the nation.

BUSINESS men, nationally, may appreciate an opportunity to express their convictions to a strictly non-partisan and impartial body—with the assurance that by so doing, business views will be presented effectively to the political, banking, industrial, business and labor leaders of the country.

QUESTIONS on the economic ballot below are prefaced with "In your line of business" to make possible an industry by industry study as well as a consensus of business opinion in all fields of industry—so let our industry be well represented in the responses.

ECONOMIC BALLOT

Check your convictions, sign, clip and mail this ballot:

1. As regards the possibility of Congress adopting a universal thirty-hour work week, do you favor such legislation? Yes ( ) No ( ); and if so on the basis of ( ) continuation of existing weekly wages, or ( ) continuation of existing hourly rates of pay.

2. In your line of business are you satisfied with enforcement of maximum hours and minimum wage provisions now in effect? Yes ( ) No ( )

3. In your line of business is there obtainable ample **working** capital—from banks? Yes ( ) No ( ); from government agencies? Yes ( ) No ( )

4. In your line of business is there obtainable ample **investment** capital—from banks? Yes ( ) No ( ); from government agencies? Yes ( ) No ( )

5. In your line of business do you favor limitation of industrial output—by government control? Yes ( ) No ( ); by industry control? Yes ( ) No ( )

6. In your line of business do you favor a plan for control of prices—by a code provision establishing price fixing? Yes ( ) No ( ); by a code provision establishing an open price plan? Yes ( ) No ( )

7. In your line of business do you think that government measures now in effect are **helping** small and medium sized enterprises? Yes ( ) No ( ); hurting such enterprises? Yes ( ) No ( )

Signed .....

Firm .....

Business .....

Please return this ballot to
The Associated Business Papers, Inc.
330 West 42nd St.,
New York, N. Y.

THE NATION'S STRENGTH IS THE NATION'S HEALTH

The greatest threat to the nation's health is tuberculosis. It is the chief killer of men in industry between the ages of 15 and 45—20,000 men in this group alone die of it every year. No one is safe from the disease until every case has been found and placed under treatment. Help protect yourself and your family by using Christmas Seals on your holiday letters and packages. The funds they provide finance a program of prevention, discovery, and treatment of tuberculosis throughout the entire year.

The NATIONAL, STATE, *and* LOCAL TUBERCULOSIS ASSOCIATIONS
of the UNITED STATES

BUY CHRISTMAS SEALS

Tribute to a Great American

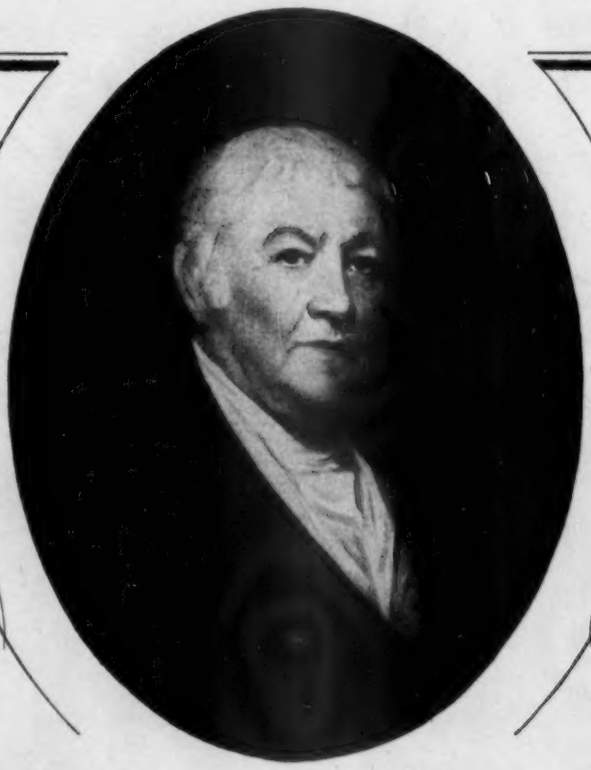
On December 22, 1800, Paul Revere wrote to a friend: "I have engaged to Build me a Mill for rolling Copper into Sheets, which for me is a very Great Undertaking, and will require every Farthing which I can Rake or Scrape."

The mill was built . . . and Revere's copper was soon the standard of the Colonies. His copper was used to roof many important buildings; his bells sounded from sixty churches throughout New England; and his spikes, bolts, and copper sheathing were used for the new fleet of frigates . . . headed by the famous "Old Ironsides."

Looking back over these Colonial days, Revere Copper and Brass Incorporated recognizes that it owes more to the illustrious "midnight rider" than the fact that he founded the present company. For Revere was great, not only as a patriot, but as the foremost industrial pioneer. He tirelessly sought to do things in new and better ways. And as an artist and craftsman, he insisted on fine materials and painstaking workmanship.

It is this spirit, maintained through one hundred and thirty-four years of growth and consolidation, that is this company's proudest possession.

Paul Revere



REVERE COPPER AND BRASS INCORPORATED

Founded by Paul Revere

Season's Greetings

To all four corners of the earth and across the seven seas, metaphorically speaking, The Welding Engineer sends a message of Christmas greeting to its readers, and adds the anticipation that they will realize in full the auspicious hope that rests in the New Year. Since the oldest of Christmas stories is built around the theme of universal brotherhood and peace, our expression of goodwill at this time is particularly appropriate because our "family" is a heterogeneous, international one. Our army of readers is not found just in the marts of civilization, but also far from the beaten paths of commerce, even to the most farflung frontier of the industrial world. This message will be read by a mine superintendent on the Island of Cyprus in the Mediterranean, and a welding firm in Tasmania, lying off the southern coast of Australia, who always asks for two copies. Then, getting closer to home, a boat will deliver our message into the little Island of Trinidad, just off the northern coast of South America, where Usine St. Madeline looks for us every month. (Sorry we don't know who Usine is, but Santa Claus does, so we are depending on him and the mails.) While speaking about islands, we mustn't fail to mention our readers in Cuba and Porto Rico, in the Hawaiian Islands and Philippines, the Dutch East Indies, the gold dredging company in New Guinea, also the Land of Nippon, as well as the twenty-six located in New Zealand. Of course such familiar names as London, Paris, The Hague, Berlin, Torino (Fiat Motors), Moscow, Berne, Stockholm, Madrid, Helsingfors, Essen-Ruhr, Amsterdam, Brussels, Manchester, Budapest, Singapore, Edinburgh, Calcutta, will be passed over hurriedly. To the sixty-five or so in the USSR, we cry out "Skohl!" which we understand is Russian for "Howdy." With that part of the world covered, we jump back again to our own hemisphere, and greet the chief engineer of a petroleum company in Peru, and offer our greetings to readers in Patagonia, in Buenos Aires, to welders up high in the Chilean Andes, and stop at Sao Paulo and Rio de Janeiro, then far northward into Tampico, then across the Rio Grande. And just before hitching up his reindeers, Santa will hail a merry greeting from The Welding Engineer to our Alaskan friends, his last stop being with a gold producing company near Nome. If we could realize the fancy of the child on Christmas eve, when all distance is obliterated, our Season's Greetings would reach all on the instant we send it. Since we must depend on material things to span space, we hope our friends will realize the sincerity of our wish even though it arrives after the Christmas rejoicing is over, or perhaps even after the New Year is on its way. To all, again, we say, A Merry Christmas and Happy New Year.

AN ADVERTISEMENT FOR NICKEL-BEARING WELDING RODS MANUFACTURED BY THE INTERNATIONAL NICKEL COMPANY

"I Cover The Welding Front"

By Nick Rodder

THIS new rush of dispensing, winery and distilling equipment is keeping me busier than a one-eyed man in the Streets of Paris.

Last week, for instance, I'm shot over to Chicago to straighten out a shop that had a rush order for some "beverage dispensers".

Ten of them were pure Nickel, and one, by way of trial was made of Inconel.

The welder at the shop was up in the air. He knew how to handle the straight nickel job, but the Inconel (Chrome Nickel alloy) had him stumped. Said the flow of metal was "sluggish".

Well, I got him off in a corner and we went into action. We set up two pieces of Inconel scrap and welded them, using a definitely reducing flame, with a feather about ¼" long. After the joint cooled, he bent it through 90° one way, then 90° the other. His eyes nearly popped out.

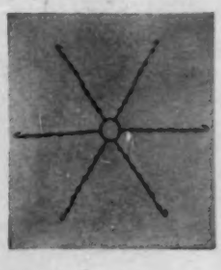
He'd been using too high a heat and too sharp a flame. Didn't give the metal time to flow together, but after he tried his own hand at it he got the hang of it. It was just a case of using a softer flame with a good feather on it, together with a simple jig that made the job a cinch. When I left, the welder slipped me a cigar his brother-in-law had given him. He'd been saving it for Sunday, but said he wanted *me* to have it!

I've been called in on all sorts of jobs, from changing a tire for the Boss' wife to attending the wake of a deceased customer. But one of the most ticklish assignments I've had handed me was to help a textile machinery manufacturer weld Monel Metal kier chain to replace steel chain formerly used. Of course, the steel rusted and stained the goods.

Chain was a little out of my line, up to then. But after all it was a welding job and up to me. When I landed at the plant it wasn't much different from any other Monel Metal welding job.

The links were formed from 7/16" hot rolled Monel, with an eye at either end. At the center of the link there is only a single cross section of 7/16" rod.

The acetylene man was an old hand, but even he was a little jittery, and inclined to give her too much temperature. We cut down the heat, that stopped overheating and burning the metal. Inside of an hour we were turning out Monel Metal chain that would have held a battleship.



☼ ☼ ☼

The boss has just handed me a telegram to hop on the Pennsy flyer and go to Harrisburg on some good sized Nickel-Clad Steel hoppers. If I get back in time, I'll tell you about it next issue. Until then, keep me in mind if you run into any tough situation that threatens to stump your regular crew. Working together, we'll straighten it out.

As ever,

Nick Rodder

INCO WELDING SERVICE

INCO WELDING RODS and FLUXES

for **PURE NICKEL**

Oxy-Acetylene . . . "T" Nickel Gas Welding Wire.
Metallic Arc . . . INCO Nickel Metallic Arc Welding Wire No. 31.
Carbon Arc . . . INCO Nickel Carbon Arc Welding Wire No. 21.

for **MONEL METAL**

Oxy-Acetylene . . . Monel Gas Welding Wire. For flux see * below.
Metallic Arc . . . INCO Monel Metal Arc Welding Wire No. 30.
Carbon Arc . . . INCO Monel Carbon Arc Welding Wire No. 20.

for **INCONEL**

Oxy-Acetylene . . . Inconel Gas Welding Wire. For flux see ** below.
Metallic Arc . . . Inconel Metallic Arc Welding Wire No. 32.

for **NICKEL-CLAD STEEL**
(for welding of Nickel side)

Oxy-Acetylene . . . "T" Nickel Gas Welding Wire.
Metallic Arc . . . INCO Nickel Metallic Arc Welding Wire No. 31 and No. 35†.
Carbon Arc . . . INCO Nickel Carbon Arc Welding Wire No. 21.

FLUXES

*INCO Gas Welding and Brazing Flux for Monel Metal.
** "Cromalloy" Gas Welding Flux is recommended for Inconel.
† For vertical welding.
No flux is used for the gas welding of Pure Nickel or Nickel-Clad Steel.

INCO welding materials as listed can most conveniently be obtained through regular INCO distributors.
Detailed welding instructions furnished on request.

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL STREET, NEW YORK, N. Y.

STOODITED CRUSHERS

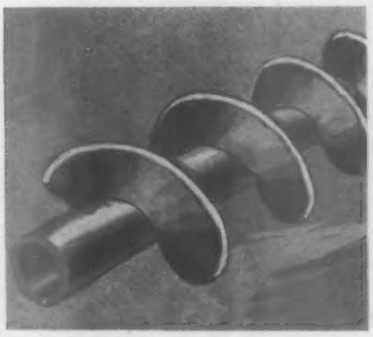
It is easy to apply Stoodite electrically to steel crusher jaws, and the jaws coated with Stoodite will outlast several sets of unsurfaced equipment.

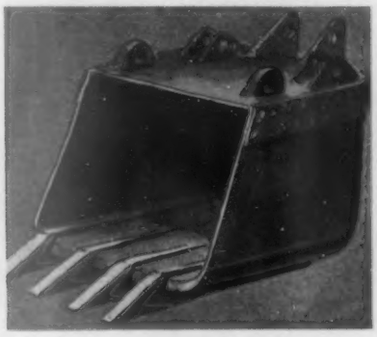
Write for particulars.

STOODY COMPANY

WELDING RODS « « ALLOY STEELS » » EQUIPMENT

WHITTIER, CALIFORNIA





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Try AMSCO No. 459 Hard-Facing Rod on your work. Pug Mill Knives, Plow Shares, Dipper Teeth, Drag Chains, Crusher Parts, Heavy Machinery Parts, Screw Conveyors, Pusher Shoes and hundreds of other machine and equipment parts are readily salvaged by hard surfacing with AMSCO No. 459 Hard-Facing Rod.

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1. Easy to apply with torch or electric arc.
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3. Much tougher than other hard-facing materials with comparable abrasion resistance; does not crack, chip or spall off.
4. Being iron base, it fuses readily with iron or steel and is better adapted to this work than hard-facing containing no iron.
5. Its qualities of adhesion and toughness are not lessened by heating and quenching.
6. Presents outstanding resistance to wear and abrasion, even under impacts that chip off other hard-facings.
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ARCOS, Inc.
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Write for New Bulletin on STAINLESS WELDING

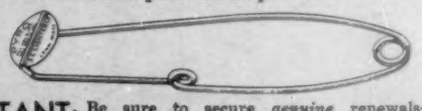
The "ROUND FILE" IMPROVED GAS LIGHTER

Price 25 Cents

Safe! — Sure!! — Swift!!!

The safety, swiftness of action, and economy of the "Round File" Improved Gas Lighter make it truly the Welder's Favorite. The hood is designed to form a pocket for the gas, *insuring immediate ignition. Economical*—the "Round File" construction affords a very large file area. The large spark metal insures more ignitions. Patented locking slip-on renewal cartridge permits of immediate replacement. Cadmium plated to prevent rust. *Try this superior lighter.*

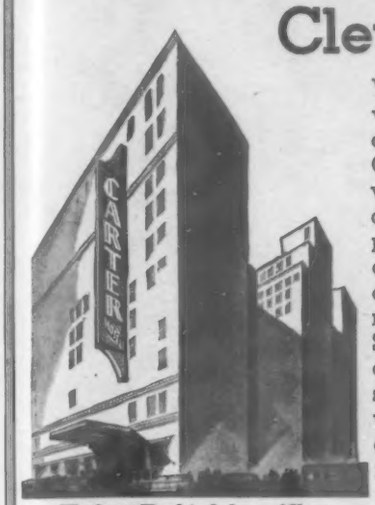
Our *Pyro Lighter*, illustrated below, is widely recognized as the best *flat file* lighter on the market. Renewal will give approximately 1500 ignitions. Write for our *low price* on this fast-selling lighter. We also manufacture the "Round File" POPULAR Gas Lighter—information and price on request.



IMPORTANT: Be sure to secure *genuine* renewals—look for name SAFETY GAS LIGHTER CO. on envelope.

SAFETY GAS LIGHTER CO. Est. 1901 **LYNN, MASS.**

When You Come to Cleveland



The Carter Hotel, in the heart of Cleveland is conveniently located close to leading department stores, theatres, banks and transportation terminals.

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When next you visit Cleveland come to the New Carter Hotel. A warm welcome awaits you—prompt, courteous service and delicious food at reasonable prices. Six hundred large, comfortable outside rooms each with private bath and circulating ice water. Exceptional facilities for conventions and sales meetings. Personalized management.

The CARTER HOTEL

PROSPECT NEAR EAST NINTH

CLEVELAND, OHIO

WILLIAM T. CRUSE, Manager

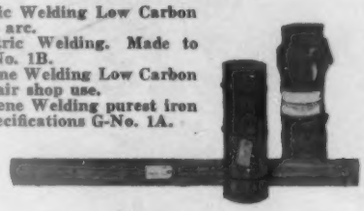
IRON STEEL WIRE "SENECA" QUALITY TRADE MARK SERVICE

Why Guess? Buy Seneca!

You cannot afford to guess what your finished weld will be like any more than an engineer can afford to guess whether the building will stand up.

Seneca Brand Welding Wire, made under strict laboratory supervision, backed by 29 years' experience in wire manufacturing, removes all the guess work.

Grade No. 1—For Electric Welding Low Carbon Wire with smooth action in arc.
Grade No. 2—For Electric Welding. Made to A. W. S. Specifications E-No. 1B.
Grade No. 3—For Acetylene Welding Low Carbon suitable for all general repair shop use.
Grade No. 4—For Acetylene Welding purest iron stock made to A. W. S. Specifications G-No. 1A.



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FOSTORIA Est. 1905 OHIO

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How to plan, direct, and safeguard arc-welded construction in bridges and buildings—

Arc-Welded Steel Frame Structures

by GILBERT D. FISH

Consulting Structural Engineer; Consulting Engineer, Westinghouse Elec. & Mfg. Co.

401 pages, 6 x 9, 211 illustrations, $5.00

THIS is a reference work for engineers, contractors and all others interested in the use of arc welding in structural work. Its purpose is to provide a great variety of information, both technical and practical, that will help in deciding when arc welded construction can be used more advantageously than bolted and riveted construction, and in handling all phases of the work with safety and economy.

Contents

1. Review of Welded Buildings and Bridges. 2. The Arc-Welding Process. 3. Specifications. 4. Physical Properties and Stress Analysis of Arc Welds. 5. Design of Arc-welded Connections. 6. Economy. 7. Construction. 8. Estimating. 9. Details and Shop Drawings. 10. Supervision. 11. Some Conclusions Drawn from Experience.

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Torchweld Equipment Company extends their best wishes for a

Merry Christmas

and a Most

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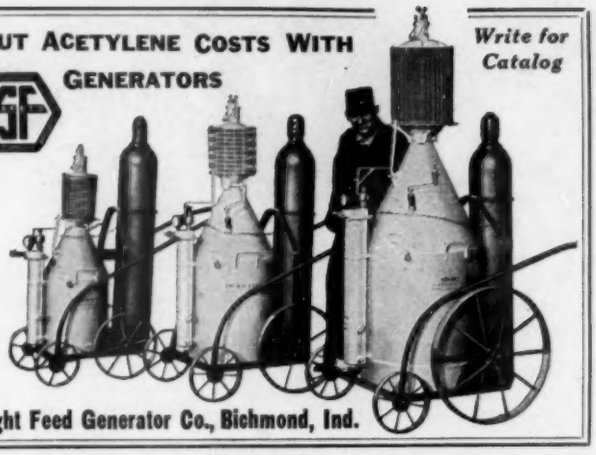


Sight Feed Generator Co., Richmond, Ind.

Greetings of the Season

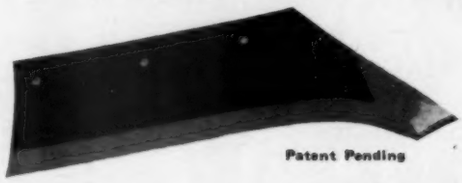
from

METAL BOND MFG. CO.

Makers of welding and soldering products.

METAL BOND MFG. COMPANY 4211 No. Broadway St. Louis, Mo.

MAKE MONEY—
Reclaiming Old Plow Shares



Patent Pending

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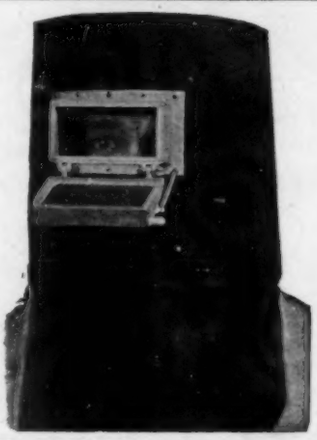

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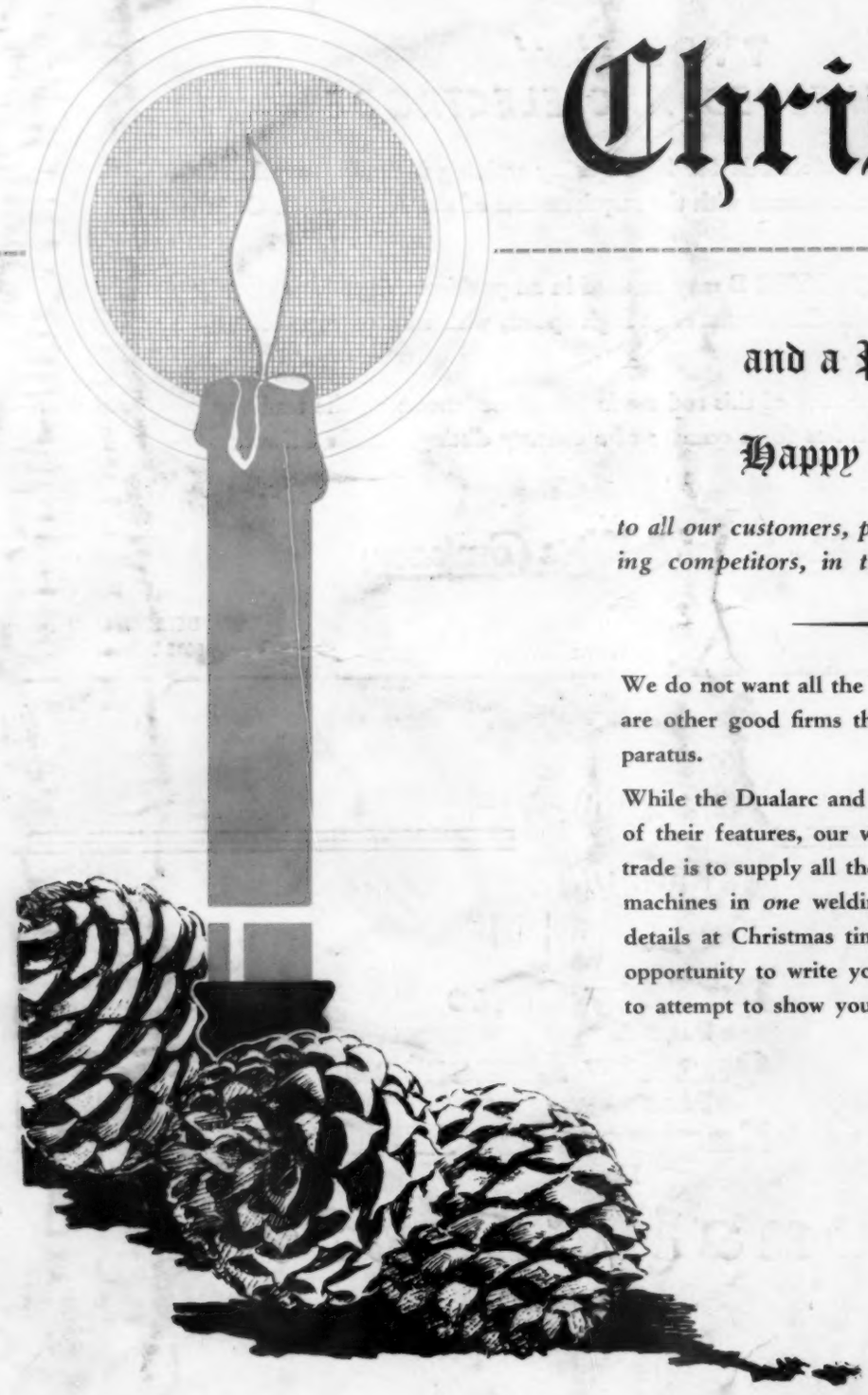

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